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The Identification of the Rayons

A Discussion and Comparison of the Various Properties and Tests Used in Identifying the Different Rayons, with Particular Attention to Acetate Silk.

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BEFORE attempting to dye, or in fact to conduct any other process on rayon, or materials containing it, the dyer should know exactly the variety of rayon he has to handle. Each different process of rayon manufacture produces a product which differs in some points from all other rayons and fibers. In the case of acetate silk, the product differs widely from all other commercial fibers in many ways. These very differences form the basis of the many ways of identifying the products of the various methods of rayon manufacture. Of course, the point which is of major interest to the dyer is their differences in dyeing properties, such as dyestuff affinity, fastness, exhaustion, etc. Most dyers are so familiar with the older rayons that once they are identified, they know how to handle them.

While a number of methods for the detection of rayon, as well as the identification of the particular variety present, have appeared in the literature, no one of these methods is applicable in every case to give the full details usually necessary to the dyer. The difference between the rayons on one hand and true silk or mercerized cotton on the other, show up readily under the microscope, while the differences between rayon, cotton, linen, wool, etc., are plainly visible to the eye alone. However, it is difficult to identify the variety of rayon even under the microscope, which is not always available, so that chemical tests are also necessary.

Solubility Tests

One of the simplest and easiest tests of individual fibers for acetate silk (Lustron, Celanese and Rhodiaseta) is its solubility in acetone. Johnson finds samples of Lustron which are not completely soluble in acetone. Warming hastens the solution, although they are also soluble cold within a short time. The fact that this method may be used upon either white or properly dyed acetate silk gives it a considerable advantage over the colorimetric tests. However, if the acetate silk has been saponified in dyeing or otherwise, it will not be completely soluble in acetone. But if the acetone solution is evaporated, a film of cellulose acetate will remain, showing the presence of this compound.

It is also more or less soluble in warm 65 per cent or stronger acetic acid, particularly glacial acetic acid. The older regenerated cellulose rayons are not soluble in either acetone or acetic acid. It has been shown by Professor Johnson[1] that there is some difference in the relative strength of acetic acid required to dissolve Lustron and Celanese. Near the boil, 30 c.c. of 50 per cent acetic acid will dissolve 0.05 grams of Celanese, while under the same conditions it requires acetic acid of 65 per cent strength to dissolve Lustron. (These quantities, of course, do not represent limits of solubility but are intended simply to emphasize the difference in strength of acid apparently required to affect solution.) Furthermore, upon pouring the 30 c.c. of acid containing the Celanese into 15 c.c. of water, a bulky opaque mass is obtained which soon forms a fluocculent sediment. Upon diluting the Lustron solution in a similar manner, only a slight opaqueness and some evidence of a translucent sediment are obtained. Where this test is made upon white acetate silk, the precipitate is white, but where the colored fiber is used in testing, the precipitate is frequently colored. Equal quantities of rayon should be used and the volumes kept the same in making the precipitation tests.

Acetate silks prepared from the older primary cellulose acetates are soluble in chloroform, while the later secondary cellulose acetate silks are only more or less plastic in chloroform alone, but are soluble in acetone. While Lustron is soluble in chloroform, Celanese only forms a jelly in this solvent and not a complete solution.[10] Both

*Now in press.

varieties are soluble in glacial acetic acid, as well as more slowly in cold concentrated sulphuric acid. Acetic silk is soluble in tetrachlorethane and alcohol while the other rayons are not Undenitrated Chardonnet rayon is soluble in cold amyl acetate.

Ammonical Copper Oxide Solution

Acetate silk is swelled by, but is not soluble in, ammonical copper oxide solution (Schweitzer's reagent), while the other rayons swell and dissolve, as also does fibroin (true silk). This reagent should be freshly prepared by dissolving 5 grams of copper sulphate crystals in 100 c.c. of boiling water and adding sodium hydroxide solution until the precipitation is complete. Wash the precipitated copper hydroxide free of alkali and dissolve it in the least possible quantity of concentrated ammonium hydroxide solution. It is best preserved away from light.

Chromic Acid

A half-saturated solution of chromic acid dissolves true silk slowly, and the rayons in the cold, while acetate silk only swells and is not dissolved. This reagent is prepared by mixing potassium bichromate with an excess of sulphuric acid. Crystals of chromic acid separate. These are removed and dissolved in water to give a saturated solution, which is diluted with an equal volume of water for use.

Water and Alkali Tests

Acetate silk does not swell in water, while all other rayons are turgoids and swell to some extent. Some of the recently proposed treatments for preserving the strength of the older rayons when wet may affect this swelling of the older rayons to some as yet unknown degree. The older rayons also lose a larger proportion of their dry strength when wet than does acetate silk. The acetate silks do not withstand the action of hot sodium hydroxide or other strongly alkaline solutions, in which they lose luster, as described in Chapter IV. The other rayons withstand this treatment better than acetate. They all swell to some extent, but none dissolve, so that this test will readily serve to distinguish the rayons from true silk and wool.

The Burning Test

Another very simple test is the burning test which has been widely recommended for distinguishing the acetate silks from all other fibers. In making this test the fibers should be rolled into a tight little ball or wad and placed near the flame without touching it. With sufficient heat the acetate silk appears to melt rather than burn, in somewhat the same manner as sugar, forming a black globule which proceeds the small flame down the thread. Upon extinguishing the flame, the small lump on the acetate silk is rather hard.

Cotton burns with a flash[21], little odor and almost no ash. Nitro, viscose and cuprammonium silks readily burn, like cotton, without melting, and leave almost no ash, which is soft. Vegetable fibers sometimes leave a slight ash in the form of the thread. The smoke has the odor of burning paper and turns moistened blue litmus paper red.

Wool and silk are readily distinguished from the natural and artificial cellulosic fibers, such as cotton, linen, rayon, etc., in the burning test. The animal fibers leave a shining, tumefied, difficultly combustible cinder, which leaves considerable ash when completely burned. The smoke has the characteristic odor of all burning nitrogenous animal matter, and turns moistened red litmus paper blue. It also turns tumeric paper brown. Wool and silk may also be distinguished from the rayons and vegetable fibers by the yellow color developed when steeped in either nitric or picric acid solution, the cellulosic fibers remaining uncolored.

According to Clayton,[2] when a heavy cord of Celanese is placed near, but not in, a Bunsen burner flame, as the temperature rises the color of the fiber changes from white to yellow and yellowish-brown, finally becoming brittle, almost like a stick of sugar which has been heated to its melting point and allowed to cool. When in direct contact with the flame, a slow burning action occurs with the formation of a black molten pellicle at the burning end. More or less charred globules may fall from the end of the burning Celanese yarn, especially if it is held intermittently in a vertical plane over the burner. He states that when cellulose acetate is heated in the air, it is gradually converted into a semi-liquid phase (possibly slightly beyond the point at which decomposition begins) and further heating causes its more or less complete decomposition. Cotton and the other rayons do not pass through a liquid phase upon heating in the presence of air. Acetate silk quickly loses its tensile strength at elevated temperatures, as do also wool and true silk but to a less extent, and this may serve as a quick test to distinguish it from the other rayons and cotton. One or two passes above a Bunsen flame is usually sufficient to disrupt acetate silk yarn or cloth.

The Acetate Test

The "acetate test" has frequently been recommended as a test for acetate silk. Possibly the best method of making this test is to dissolve the fiber in a little chloroform and boil this solution with a normal solution of sodium hydroxide. Dilute with water, and filter off the precipitated cellulose and evaporate the solution just to dryness. Add sufficient water to dissolve the residue and acidify with sulphuric acid. Add a little ethyl alcohol

and the same amount of sulphuric acid, warm, and if the sample contained acetate silk, the odor of ethyl acetate may be detected.

Trotman and Trotman[16] suggest boiling the rayon sample with a solution of potassium hydroxide, when potassium acetate is formed in the presence of acetate silk. This filtered solution may be concentrated, carefully neutralized, and a little neutral solution of ferric chloride added. If acetate silk was present, the red color of ferric acetate is apparent and upon boiling, a red precipitate of basic ferric acetate is formed, while acetic acid is liberated and its odor may be detected.

As a shorter test, the filtered potassium hydroxide solution, after boiling the sample, may be concentrated to a small volume, cooled, and acidified with sulphuric acid If the sample contained acetate silk, the characteristic odor of acetic acid is present on warming.

The Acetamide Test

Clayton[2] proposes the acetamide test, when other methods fail, for acetate silk. This may be used on either white or dyed fibers. A hard glass test tube is drawn out near the middle, so that the opening left can be subsequently closed quickly with a suitable flame. A few strands of the fiber are introduced into the tube and ammonia added to about one-tenth the capacity of the tube. Before sealing the tube, the ammonia should be heated gently to drive out most of the air, and if possible the fibers are arranged in the upper portion of the tube as sealed. The tube is then sealed, surrounded by a safety screen, and the lower portion placed in a suitable oil bath, the temperature of which is slowly raised to about 120 to 140 deg. Cent., and held at this temperature for thirty to sixty minutes. On cooling the tube and opening it, the odor of a small amount of impure acetamide will be detected, if the fiber sample contained acetates.

Distinguishing Lustron and Celanese

Perhaps the most complete paper upon the identification of the rayons is that of Professor Johnson.[1] In addition to the acetic acid test just mentioned, he recommends the following reagents:

(1) Diphenylamine; a 1 per cent solution in concentrated chemically pure sulphuric acid.

(2) Various dye solutions; 1 part of dyestuff in 1,000 of water.
   (*a*) Methylene Blue.
   (*b*) Pontamine Scarlet B, or its equivalent.
   (*c*) Sulphur Khaki Y, or its equivalent.

(3) Millon's reagent; Dissolve metallic mercury in its own weight, of chemically pure concentrated nitric acid and then dilute with an equal volume of water.

Before making the colorimetric tests upon dyed rayon, it is usually necessary to "strip" the color from the fiber. This may be done by the usual methods with hypochlorite, peroxide, permanganate, hydrosulphite, or a hydrosulphite-formaldehyde compound, such as Protolin AZ, in a solution containing acetic or formic acid. The latter method is recommended, but will not remove all dyes from acetic silk. Care must be observed that the stripping operation does not so alter the rayon as to obviate the results of the identification tests. Samples for testing should be of a white color, if possible, and free from sizing, oils, bleaching, or other chemicals or foreign matter.

Dyeing Tests

Lustron and Celanese in the absence of nitro rayon may be distinguished by boiling a few threads of the sample in 10 to 15 c.c. of the 2*a*-Methylene Blue solution, as above, acidified with 1 or 2 c.c. of acetic acid. Wash the dyed samples well in water. The Lustron retains a deep blue color, but the color of the Celanese washes out to a comparatively pale blue. This difference is entirely due to, and is typical of, the affinity of the two fibers for the basic dyes. While the basic dyes have a greater affinity for Lustron than any other known textile fiber, this is decidedly not the case with Celanese. Dort[3] states that this test is not always reliable.

Ginsberg[4] states that if a rayon sample is placed in a solution of 3 per cent Methylene Blue and 2 per cent acetic acid, nitro silk will rapidly assume a marine-blue color, quickly exhausting the bath, while viscose and cuprammonium silks are only slightly dyed and leave the remaining bath thick. Acetate silk (probably Celanese) is not dyed, but after soaking in diluted alcohol or other suitable swelling solvents, the dyestuff is quickly absorbed into the fiber. If Lustron and Celanese are dyed together in the same dye bath at the same time with a basic dye such as Rhodamine or Malachite Green the Lustron will take on a very full shade while the Celanese will show only a comparatively light shade. Celanese is claimed to have a slightly greater affinity for the Ionamines and SRA dyes than Lustron, and it has been stated that they may be differentiated by this test. None of the other rayons are dyed by either the Ionamines or dispersol dyes; however, some of them stain wool and true silk to some extent. The luster of Celanese and Rhodiaseta is impaired by boiling it in pure water, while Lustron withstands this treatment very well.

True Silk

Upon treating the unknown sample with Millon reagent and warming gently, true silk is colored a brick-red, while all of the rayons, including acetate silks, are unstained. Animal fibers may also be identified by the fact that when boiled with a decolorized solution of magenta and afterwards well washed, they assume a pink

color, while all other fibers are colorless. This reagent may be prepared by dissolving 0.1 gram of magenta (fuchsin in 100 c.c. of water and adding sulphurous acid solution until it is just decolorized. The sulphurous acid solution is conveniently prepared by dissolving sodium bisulphite in water and then acidifying with hydrochloric acid.

Ammoniacal Nickel Oxide Solution

Ammoniacal nickel oxide reagent swells but does not dissolve either acetate or the older rayons. However, it dissolves true silk almost immediately. It is prepared in almost the same manner as the corresponding copper oxide reagent. Dissolve 5 grams of nickel sulphate in 100 c.c. of water and add sodium hydroxide solution until the nickel hydroxide is completely precipitated. Wash the precipitates free of alkali and dissolve in 25 c.c. each of concentrated ammonia and water.

Alkaline Copper Solution

Copper-glycerol reagent may also be used to distinguish between rayon and true silk. While it quickly dissolves the latter, it is without action on any of the rayons, including acetate silk. This reagent is prepared by dissolving 10 parts of copper sulphate in 100 c.c. of water, adding 5 parts of glycerol and then sufficient concentrated aqueous potassium hydroxide to completely dissolve the precipitate at first formed. Of course, it is understood that the acetate silks lose luster on warming in this reagent.

According to Formhals,[5] true silk, even if weighted and dyed, may be distinguished from rayon by treating a small portion of the sample for a short time in a few cubic centimeters of concentrated sulphuric acid, diluting the mixture with water, adding sodium hydroxide to alkalinity, and then adding diazotized *p*-nitroaniline solution. Natural silk gives a red solution under these conditions, while the rayon solution is yellow. Very probably the presence of wool would also give a red solution similar to silk.

Nitro Silk

Upon wetting a fiber of nitro silk with the diphenylamine solution, it is at once colored blue and dissolves in a few minutes. Another method suggested for identifying the nitro silk is to dissolve the samples in concentrated chemically pure sulphuric acid and add brucine sulphate to the solution. This gives a bright red color when nitro is present. Undenitrated nitro silk is soluble in amyl acetate and very flammable.

Schwalbe[6] states that if 0.2 gram of rayon is heated in a test tube with 2 c.c. of Fehling's solution, nitro silk imparts a green color to the solution, probably due to its oxycellulose content, while viscose and cuprammonium silks do not decolorize the solution under the same conditions. In some cases the nitro silk may have a yellowish to red copper oxide precipitate on the fiber.

Distinguishing Viscose and Cuprammonium Silks

If true silk, acetate and nitro silks are absent, viscose and cuprammonium silks may be distinguished by comparative staining with the Pontamine Scarlet B (Johnson's 2*b* solution) or Sulphur Khaki Y (2*c*), both of which have a greater affinity for the cuprammonium than for viscose silk. In this test as well as in all others, it is recommended to use standard samples of the rayons from known sources for comparison in running the tests. In dyeing with the Scarlet, about 1 per cent of dyestuff, on the weight of the fiber, should be used. With the Khaki, use about 3 per cent dissolved with two to four times as much fused sodium sulphide as dyestuff.

A 1 in 2,000 solution of Naphthylamine Black 4B (Cassella), a mixture of Colour Index Nos. 246 and 308, dyes cuprammonium silk[17] dark bluish-gray and viscose a light reddish-gray, or a light bluish-gray (linters) from a hot neutral bath. It will be noticed that under the Ruthenium Red tests that whereas viscose is colored a bright rose, cuprammonium remains almost colorless.

The Silver Tests

Gotze[7] states that a 1 per cent ammoniacal silver nitrate solution colors viscose a distinct brown, while under the same conditions cuprammonium silk remains colorless. He attributes the brown color to a deposit of finely divided silver in or on the fiber and not to the silver sulphide.

Rhodes[8] obtains better results with a reagent containing 1 per cent of silver nitrate, 4 per cent of sodium thiosulphate, and 4 per cent of sodium hydroxide, than with Gotze's reagent. The reagent is prepared by dissolving each chemical separately in water, adding the silver nitrate to the sodium thiosulphate solution, and when the precipitate which at first forms has dissolved, adding the sodium hydroxide solution. This is brought to the boil and filtered. The sample should be immersed for one minute in the boiling solution, when viscose is colored a deep red-brown, while cuprammonium silk remains almost white. The color of the viscose sample is very similar to 2.5 to 4 per cent Chlorazol Brown M (C.I. No. 420, B.D.C.) dyeing. Nitro silk is also stained by both the Gotze and Rhodes tests, very probably due to its sulphur content, from the denitrating process, but may readily be differentiated from viscose by the diphenylamine test. Table I gives the results obtained by these two tests:

TABLE I

Colors on Viscose, Cuprammonium and Nitro Silks by the Gotze and Rhodes Tests as Compared with Chlorazol Brown M[8]

Variety	Gotze Test Color	Rhodes Test Color
Cuprammonium Silk	0.00 per cent Chlorazol Brown M	0.00 per cent Chlorazol Brown M
Viscose Silk	0.30 per cent Chlorazol Brown M	2.50 per cent Chlorazol Brown M
Vistra Silk	1.00 per cent Chlorazol Brown M	4.00 per cent Chlorazol Brown M
Nitro Silk (denitrated)	0.60 per cent Chlorazol Brown M	3.25 per cent Chlorazol Brown M

Harrison[9] used a thiosulphate silver solution as a test for oxycellulose, consequently certain forms of cuprammonium silk which are known to contain oxycellulose may become colored by this test but the shade is grayer or less brown in character. Rhodes[8] points out that this grayer color in the presence of oxycellulose indicates that the brown on viscose and denitrated nitro silks, both of which contain sulphur, is not due to a precipitation of colloidal silver but to the presence of sulphur in the fiber.

According to Kraise,[17] the very fine viscose silks now on the market do not always give exactly the same colors in certain tests as the heavier fibers. He gives Table II, showing the colors on the various fibers by the different methods and recommends the Rhodes and Naphthylamine Black tests.

TABLE II

Color Tests on Various Rayons

Variety	Naphthylamine Black 4B[17]	Gotze[7]	Rhodes[8]
Viscose, 7-8 den.	Light reddish-gray	Rust-brown	Very dark blackish-brown
Viscose, 4 den.	Light reddish-gray	Rust-brown	Lighter blackish-brown
Viscose (linters) 7-8 den.	Light bluish-gray	Light rust-brown	Still lighter blackish-brown
Cuprammonium 1-2 den.	Dark bluish-gray	Light yellowish brown	Very light gray
Nitro	Light reddish-gray	Rust-brown	Very dark blackish-brown
Acetate	Light reddish-gray	Light brown	Bluish-black

Schreiber and Hamm[20] recently found that the traces of sulphur compounds remaining in viscose silk cause it to give a sulphide test with lead acetate paper which is not given by cuprammonium silk. In making this test they recommend that a 5 gram rayon sample be placed in a flask with 100 c.c. of water and 3 c.c. of concentrated sulphuric acid. The mouth of the flask is closed with a diaphragm of filter paper saturated with a 10 per cent solution of lead acetate, and the flask heated over a moderately boiling steam bath for four hours. If at the end of this time the exposed part of the lead acetate paper is stained brown or black the sample is viscose, while the absence of color indicates cuprammonium silk. They do not give any data upon the behavior of nitro or acetate silk under this test, but they were unable to obtain a positive test for carbon disulphide remaining in viscose.

Sulphuric Acid Test

Maschner[10] states that the rayons may be identified by placing 0.2 gram samples in small dry Erlenmeyer flasks standing on a white surface. Add about 10 c.c. of chemically pure concentrated sulphuric acid simultaneously to each flask and shake gently to thoroughly wet the fibers. Note the immediate effect and continue the observation for about an hour and a half. Nitro silk is at first quite colorless, but in forty to sixty minutes the liquid assumes a weak yellowish tone. Cuprammonium silk immediately takes on a yellow to yellowish-brown tone and the liquid becomes yellowish-brown after forty to sixty minutes. Viscose silk is at once turned reddish-brown by the acid and after forty to sixty minutes the liquid is a rusty-brown color.

Clayton[2] reports that the concentrated sulphuric acid test used to distinguish between viscose and cuprammonium rayons appears to be based partly on the assumption that the viscose gives hydrolysis products of a deeper color than those of cuprammonium. He claims that these tests cannot be regarded as conclusive, and that in carrying out the test it is important to give particular attention to any color change occurring in the first fifteen to thirty seconds. The viscose becomes yellowish-brown while the cuprammonium is colored a reddish-yellow. Tests for copper in the latter fiber are not always successful either, and he recommends a dyeing test as a check upon the results obtained by the other methods. On account of the greater hydration of the cuprammonium rayon, it is invariably dyed more deeply than viscose rayon when they are simultaneously placed in the same direct dye bath. He recommends Sun Yellow R in very dilute solution, in the presence of a little alkali, for this test.

Ruthenium Red Test

Matthews[11] gives a very good account of the Ruthenium Red test on various fibers. Ruthenium is one of the rare metals and most of its salts give an intensely red solution

in water. This is especially true of the aqueous solution of the complex salt of ammonia with ruthenium oxychloride, $Ru_2(OH)_2Cl_4(NH_3)_7.{}_3H_2O$. This reagent has been recommended for use in the microscopic examination of various fibers. While it is soluble in water, it is insoluble in both glycerol and alcohol. Ruthenium Red is without action on fresh liquified tissue or that preserved in alcohol, but after the action of alkalies or sodium hypochlorite, the tissue is colored a bright rose. It colors the gums and pectin matters so widely found in vegetable fibers, as well as oxycellulose, but does not color pure cellulose, such as the clean normal cotton fiber. Raw unbleached cotton is quickly colored due to the presence of pectin or cuticle. Textile fibers containing pectocelluloses, such as linen, ramie, hemp and jute are strongly colored. Kapok is practically unstained, bleached wool is uncolored even after twelve hours and bleached true silk, which is at first not colored, becomes a rose color on standing. This reagent should be freshly prepared by dissolving 0.01 gram in 10 c.c. of water. It is unstable in strong light.

Haerry[12] reports that Ruthenium Red is useful as a reagent for the identification of the rayons. Upon treating the rayon sample with the above reagent and allowing it to stand twelve hours, viscose becomes a distinct pink, more pronounced on standing. Denitrated Chardonnet (nitro) silk first becomes red but is more violet on standing. Cuprammonium silk is only slightly pink even after standing twelve hours; and acetate silk, which should remain uncolored, is sometimes irregularly tinted after twelve hours. This irregular tinting of acetate silk indicates irregularity in its composition, and the test may have some value in detecting this fault. Rayon which has received the sthenose treatment is not colored.

The Iodine-Zinc Chloride Test

According to Schwalbe[6] it is possible to distinguish between viscose and cuprammonium silks by treating them with iodine-zinc chloride reagent, and washing with water. Both silks are at first colored, but whereas the viscose holds the bluish-green color for some time, the brown color of the cuprammonium silk soon washes out. Acetate silk is colored a distinct yellow by this reagent, and nitro a reddish-violet. This reagent is prepared by dissolving 20 grams of zinc chloride, 2 grams of potassium iodide, and 0.1 gram of iodine in 15 c.c. of water. Maschner[10] reports that this test is not very satisfactory, as different samples of viscose and cuprammonium silk react in different ways.

The Iodine-Sulphuric Acid Test

The United States Bureau of Standards recently recommended a sulphuric acid-iodine solution for the identification of rayons. This reagent, possibly giving about the same result as Hoehnel's iodine reagent, is freshly prepared for each test by dissolving 1 gram of potassium iodide in 25 c.c. of water and adding iodine crystals to saturation. Pour off the clear solution and dilute this to about 25 to 50 per cent of its strength with water. Add an equal volume of 95 per cent sulphuric acid. When treated with this solution, viscose silk turns a blue color, acetate yellow, nitro violet, and cupramonium a light blue. Haller and Ruperti[13] state that fully hydrolyzed Celanese gives a blue color with iodine in potassium iodide sulphuric acid reagent, instead of the yellow obtained on ordinary Celanese. Gelatin silk, which is not a commercial product, is colored a yellowish-brown.

Clayton[2] recommends iodine solution as a quick method of identifying the various rayons. Celanese turns yellow to yellowish-brown when immersed in this solution, and the color is fairly fast to washing in water. Viscose and cuprammonium silks are colored a deep bluish-black by the same treatment but become pale blue on continued washing. This test may be applied to the dyed Celanese fibers, provided the coloring is not too deep. Unfortunately wool and true silk are also colored yellow by iodine solutions, but the burning test serves to distinguish these very readily by their nitrogenous odor. Another method of differentiating between true silk and wool on one hand and acetate silk on the other, is to immediately place the yellow-colored fibers, after rinsing off the iodine solution, in a cold 1 per cent solution of caustic soda. The color of the true silk or wool is almost instantly discharged, while the color of the Celanese persists for some time. When using very fine filaments for this test, the strength of the caustic solution should be reduced.

When Celanese is partially hydrolyzed (saponified) by treatment with a cold, very dilute solution of caustic soda, it absorbs iodine from solution with greater avidity than does the normal fiber. Even though the hydrolysis may be sufficient to allow staining of the fiber by direct dyes, the color of the iodine stained fiber is only a light yellowish-brown after washing, which indicates a rather incomplete hydrolysis. However, when the acetate silk is boiled for a half a minute in a 1 per cent solution of caustic soda, it reacts towards the iodine solution in the same manner as the other rayons and mercerized cotton. This test may therefore serve as a quick, rough test for partially or unevenly hydrolyzed acetate silk.

Identification by Refractive Index

The comparative low refractive index of acetate silk, which has been given as 1.474 to 1.4790 in connection with its properties, offers a very easy and simple method of identifying the undyed fiber either alone or in combinations with other fibers, under the microscope. It is well known that when a comparatively transparent colorless material is submerged in a liquid of approximately the same refractive index, it loses detail and under certain conditions is distinguishable only with difficulty. This principle may be used to identify, or rather to obliterate, the undyed acetate silk in a mixture of fibers.

If undyed silk fibers, or materials containing it, are mounted on a microscopic slide in a medium of approximately the same refractive index as the fiber, the acetate fibers become practically invisible under the miscroscope. In fact, in many instances there is enough visible change in the appearance of the fabric for an experienced worker to identify the acetate without putting it under the microscope. Through the microscope only the fibers other than acetate are visible. When the fiber is dyed in light shades, this method is sometimes useful, but with heavy shades the color is so plainly apparent that the method is not often of value.

The refractive index of glycerol is 1.471 and that of lemon oil 1.473 to 1.476 at 25 deg. Cent. W. Massot was possibly the first to suggest the use of glycerol in this manner, while Worden[14] suggested lemon oil for the same purpose. With Lustron and Celanese of the present type, lemon oil works very satisfactorily, while glycerol is a good substitute but is not quite so effective. The method is easy, quick and almost startling in its results to those who are not familiar with this phenomenon. In the above mediums, all other commercial fibers stand out clearly and distinctly, only the acetate silk disappearing.

Herzog[15] states that true silk may be identified and obliterated by a similar method. If a fiber of true silk is mounted in aniline, refractive index 1.599, and examined under a miscoscope with a Nicol prism, it is almost invisible when its longitudinal axis is at right angles to the plane of polarization of the prism. It becomes more and more visible, when the stage is rotated, until it reaches a maximum of visibility at right angles to the original position. The older rayons have a refractive index between that of true silk and acetate silk, and are therefore distinctly visible at all positions of the stage and prism.

Another simple test for either white or dyed acetate silk is by means of the electroscope, and is based upon the fact that all vegetable fibers and rayons, with the exception of acetate silk, will remove the static charge from the electroscope, while acetate silk, true silk, and wool do not dispell the static charge.

Garner[18] suggests that acetate silk may readily be distinguished from the other rayons by the differences in their specific gravities and mentions an aqueous 40 per cent solution of potassium iodide, Sp. Gr. 1.4, as suitable for this purpose. In this solution, acetate silk, specific gravity about 1.3, floats while viscose and cotton, specific gravity about 1.5. sink.

A. S. T. M. Tests

Subcommittee XV, of Committee D-13 of the American Society for Testing Materials, in a recent revised re-

TABLE III

Reactions of the Rayons and Natural Silk

Reagent	Acetate	Nitro	Cupramonium	Viscose	True Silk
Burning	Melts, black residue	No odor, burns slower than viscose	Easiest to ignite, no odor, slight ash.	No odor, burns slower than cupramonium.	Odor of burning feathers, black ash.
Water	No swelling	All swell	All swell	All swell	Very slight swelling
Acetone	Soluble	All insoluble	All insoluble	All insoluble	All insoluble
Acetic Acid	Soluble	All insoluble	All insoluble	All insoluble	Dissolves on boiling
Chloroform	Softens or Dissolves	All insoluble	All insoluble	All insoluble	Insoluble
Ammonical-Copper Oxide	Swells but not dissolved	Swells quickly, dissolves slowly	Swells slowly and dissolves slowly	Swell and slowly dissolves.	Fibrom dissolves
Chromic acid	Swells but not dissolved	Dissolve cold	Dissolve cold	Dissolve cold	Dissolves slowly
Million's Reagent	Unstained	Unstained	Unstained	Unstained	Colored red
Decolorized Magenta	Unstained	Unstained	Unstained	Unstained	Colored pink
Ammonical Nickel Oxide	Swells but not dissolved	Swells but not dissolved	Swells but not dissolved	Swells but not dissolved	Dissolves quickly
Alkaline Glycerol Copper	No change	No change	No change	No change	Dissolves quickly
p-Niraniline	Uncolored	Uncolored	Uncolored	Uncolored	Red
Diphenylamine	No color	Blue	No color	No color	
Brucine Sulphate	No color	Red	No color	No color	
Fehling's Solution	Blue	Green	Blue	Blue	
Alkaline Silver Nitrate			No change	Brown	
Sulphuric acid	Slowly dissolves	Quickly dissolves yellowish solution	Slowly dissolves yellowish-brown solution	Quickly dissolves Rusty-brown solution	Quickly dissolves
Ruthenium Red	Colorless	Violet	Slight pink	Pink	Rose
Iodine-Zinc Chloride	Yellow	Reddish-violet	Brown	Bluish-green	Pale yellow
Iodine-Sulphuric Acid	Yellow	Violet	Light blue	Blue	Yellow

port of proposed rayon specifications have proposed the following as tests for the different rayon varieties:

Acetate: Twist fibers to tight wad and cautiously approach to match flame

(*a*) Acetate silks "melt" or "fuse" and burn more slowly than other rayons, and harden at once into a light brittle substance globular in appearance.

(*b*) Viscose, nitro and cuprammonium silks all burn like cotton, that is, with no odor and leaving very little ash.

Acetate silk is readily soluble in pure acetone to concentrations of not over 1 per cent. This serves as a confirmatory means of differentiating acetate silks from other rayons, which are not soluble in acetone.

Nitro: Moisten the thread with a solution consisting of 1 per cent diphenylamine in concentrated sulphuric acid.

(*a*) Nitro silks assume immediately a deep blue color. The fiber dissolves rapidly to a blue solution.

(*b*) Viscose and cuprammonium silk are not colored blue and dissolve more slowly.

Cuprammonium: Immerse the thread for a minute in a boiling solution consisting of 1 per cent silver nitrate, 4 per cent sodium thiosulphate, and 4 per cent sodium hydroxide*

(*a*) Cuprammonium silk will remain unstained.

(*b*) Viscose silk will be stained a brown or reddish-brown color. This reaction will also produce a brown stain on nitro silk.

*NOTE.—In preparing this reagent, dissolve the silver nitrate and sodium thiosulphate separately. Add the first to the second and the cloudiness will disappear. Add the previously dissolved sodium hydroxide. Make up to correct volume, bring to boil, and filter.

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MISUSE AND MISREPRESENTATION OF REPORT ON ARTIFICIAL DAYLIGHT LAMP

For some months past the American promoters of an "artificial daylight lamp," said to be the "invention of a Frenchman named Gamain," have been making public reference to a test of this lamp made by the Bureau of Standards.

Unwarranted claims made for this lamp are coupled with references to tests by this bureau in such a way as to suggest the bureau's indorsement. This misuse of a Bureau of Standards' report may mislead those not technically acquainted with the history of the development of "artificial daylighting equipment" and so work an injustice to a legitimate business in the manufacture of such apparatus which has been established in this country for a number of years.

The following are the facts in this case:

1. The test report to which reference has been made (B. S. Test No. 46959) was issued on condition that it was not to be used for advertising purposes.

2. The report has been very inaccurately quoted in numerous newspaper and magazine articles.

3. There is absolutely nothing in the report to suggest that the "Gamain" lamp is in any way superior to artificial daylighting equipment of American invention and American manufacture, which has been available on the American market for many years.

As a matter of fact, the Bureau of Standards considers the design of the "Gamain" lamp inferior to the above-mentioned American apparatus.

Proceedings of the American Association of Textile Chemists and Colorists

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JANUARY MEETING OF THE PIEDMONT SECTION

The January meeting of the Piedmont Section of the American Association of Textile Chemists and Colorists was held at the O. Henry Hotel, at Greensboro, N. C., January 22. One hundred members were present.

J. E. Harden, vice-president and secretary of the Proximity Manufacturing Company, gave the address of welcome to Greensboro.

The Glee Club of the North Carolina College for Women presented a delightful musical entertainment during the banquet.

Charles H. Stone reported a deficit of $170 in the accounts of the annual meeting held at Charlotte on December 3 and 4, 1926. It was voted to meet this deficit by voluntary contributions.

It was decided to hold the spring meeting in Greenville, S. C.

No new business was brought up at the meeting.

B. D. Gaddy, of the Golden Belt Manufacturing Company, Durham, N. C., presented a very interesting paper entitled, "The Finishing of Hosiery." W. E. Phillips, technical representative of the Mathieson Alkali Works, Charlotte N. C., presented a paper on "The Use of Alkalies in the Textile Industry."

Joseph P. Jaeck, technical director of the dyestuff department of E. I. du Pont de Nemours & Co., presented a paper on "The Indigo Vat."

No discussion followed these papers.

D. S. Moss, *Secretary.*

The Finishing of Hosiery

By B. D. GADDY
Golden Belt Manufacturing Company

The short skirt and bright colored hosiery vogue has brought about many changes and many new problems in the finishing of hosiery.

Finishing has moved up from a place of secondary importance to a position of first rank in the manufacture of hosiery. With the various fabrics and numerous shades to be dyed, the dyestuff manufacturers have been called upon to produce a greater variety of dyes and the dyeing machinery manufacturers have felt the demand for more scientifically designed dyeing machinery. The dyer has had to increase his knowledge of dyes and chemicals, and the finisher has had to provide new methods and new equipment for handling an increased amount of finished stock. With all these changes progress is being made, and the finisher who is not making improvements is not keeping abreast of the times.

One of the new problems in connection with finishing is the proper care of the greatly increased amount of stock which has to be carried on account of the great number of shades. If this stock is laid out in the open, exposed to the air, dust and sunlight, it depreciates very much. Dark, dustproof stockrooms, or well-

built cabinets should be provided for this stock. Another remedy, and probably the better one, is to dye against orders and keep the stock moving, thereby reducing the stock to a minimum and reducing the cost of redyeing and refinishing obsolete shades. The problem of redyeing obsolete shades and redyes is a delicate one; the best results to be had are not altogether satisfactory. Goods which have been stripped seldom dye the correct shade and they lose much of their former strength, feel and luster. The better method is to convert them into darker shades, such as taupe, gunmetal, and black.

Standardizing for Perfect Finish

The quality of the finish does not begin in the dye house but goes back to the knitting department, then to the purchasing department. If the purchasing department does not buy standardized, uniform raw materials, they need not expect a standardized, uniform product to be turned out by the finishing department. For example, every dyer knows that yarns of different mercerization dye differently. If more than one mercerization is used the gray stock should be kept separate in the knitting room. Then there should be standardization in the knitting of the hose in minute details, even down to the temperature of the room. In cold weather, if the windows are not weather-stripped, the machines next to the windows will knit tighter and make more seconds. The small belts that pull the machines should be kept in condition to insure uniform speed of the machines, as variable speeds will produce a variable fabric. Many other similar small details should be regulated.

The same standardization should apply to the labor. There is usually some method decided upon as the best method of doing a job, then the job should be done that way. For instance, if it is decided that the knitter can do better inspecting on her right hand than on her left, then all the knitters should inspect on the right hand. A standardized, uniform product is always received favorably by the trade. This is one reason why such articles as Arm & Hammer Soda and Bull Durham Smoking Tobacco have been such popular brands in their respective fields.

Finishing is so closely interlocked with knitting the two cannot well be separated. A stocking must first be correctly designed and constructed to look well when it is finished.

The knitting department bears a close relation to the dyeing. The stock must be kept clean and free from oil spots. The most of the redyes come from oil spots. Someone, in defining lever power, said it was a 14-inch monkeywrench in the hands of a fool. Redyes could be defined with equal truth as "a pint oil cup in the hands of a fool."

Fresh knit stock, as a rule, finishes better than old stock. This is especially true of silk goods. If the silk stock is stored in the gray for a long period the oils in the silk will oxidize and turn the silk yellow. If this is dyed with fresh stock two distinct shades will be the result. There are other advantages in keeping the finishing close up with the knitting, such as keeping the knitting room advised of the various defects in the stock. When the knitter has completed his job, we come to the various operations of finishing. The first and most important is dyeing. Contrary to all practice, the dyehouse should be so constructed that it could be kept as clean as any other part of the factory. Every dyehouse should have an ample supply of clear, soft water. Water-softening equipment is strongly recommended. The best dyeing machinery equipment should be provided. Every dyehouse should be provided with sufficient laboratory equipment for matching shades and testing dyes and chemicals. A careful study of dyes must be made, and a thorough knowledge of the character of the dyes being used is necessary, if the best results are to be obtained. The successful dyer is never satisfied with present accomplishments, but is striving all the time to improve his formulae.

Dyeing Methods

There are two methods most generally used for dyeing silk hose. One is known as the one-bath method, and the other the two-bath. In the one-bath method the dyeing and degumming is done in the same bath. The advantage claimed for this method is that the time the goods are run in the machine is reduced and a slight scroop effect is made on the goods by the small amount of gum left in the goods. Due to the presence of the gum and degumming oils or soap in the dye bath, the bath is harder to control and the addition of shading colors far more hazardous, and uniform results in the duplication of shades is much more difficult in the one-bath method. The gum in the fabric during the dyeing prevents a thorough penetration of the dyes. The removal of the small amount of gum left in the goods when laundering removes some of the dye with it, causing the color to bleed. With the two-bath method, the gum is first removed, and the goods thoroughly rinsed to remove all the degumming agent. The dye is entered in a fresh, neutral bath, which is always uniform and easy to control; this makes the addition of shading colors an easy task. These, and many other reasons, might be mentioned in favor of the two-batch method. The modern dyeing

machine is constructed to dye either with or without nets, but the protection the nets give to the goods when handling to and from the machine and extractor is of much value. The nets also permit the mixing of sizes in the same pocket, which is necessary for a full loading of the machine. The most popular size net is 24 by 36 inches and should be woven of soft twist thread.

Extracting and Boarding

The next operation after dyeing is hydo-extracting; and too little attention is given to this simple operation, for the way the goods board and the way the goods retain their shape depends much on the amount of moisture left in the goods at the extractor. The amount of time the extractor should run should be varied to suit the size of the batch and the weight of the goods. It is much better to leave the goods too wet than have them too dry. To get the best results the batch should be boarded as soon as possible after extracting.

Then comes the boarding, a small operation; but the manner in which it is done contributes a great deal to the appearance of the stocking. The average stocking boarder is merely a machine with a certain stroke. He pulls them all alike, whether they be loose or tight, long or short. He is not so far wrong at that, if his stroke is right, for the stockings should be knit to fit. The only place to properly regulate the size and length of a stocking is at the knitting machine. A stocking adjusted to fit the board is only a temporary job. Too much heat on the boards will affect the finish of the hose and cause them to shrink when taken off the boards. For this reason each boarder should be given sufficient boards to allow for slow drying.

After boarding, the hose enters the finishing room proper, where the human element plays the greater part. Considerable care should be taken in the selection of the help for this department. A certain precision is necessary here if clean-cut merchandise is turned out. Such precision calls for close application and serious thought, which eliminates the frivolous flapper or careless schoolboy. Young women who are bordering on or have entered the old-maid age are to be preferred.

The old-fashioned finishing-room equipment consisted of a few rough tables strung along the walls and some empty yarn cases and a few extra case heads to lay the work on. The finished stock was piled at random about the room, which gave the room very much the appearance of a crazy quilt. We have now learned that the psychological effect of a well-ordered room will lend much to the character of the product being turned out. The modern finishing room has a place for everything and everything is in its place. Well-constructed and highly polished worktables are provided and such portable equipment necessary for the movement of stock.

Mating

The first operation after leaving the boarding room is mating, which is the most interesting of all the operations. Here the defects of all the previous operations are culled out. The mating of a batch of goods is to a hosiery manufacturer like a child opening a Christmas package. He sees what he has and experiences the same pleasures or disappointments. It brings the pleasure of work well done or the disappointment of failure.

The mater, when she has completed the batch, counts the various grades and assigns them to their respective places, and then makes out her detailed report showing just what the batch contained in firsts, seconds, mends, waste, redyes, etc. These reports tell the story of what is being accomplished by the combined efforts of the whole organization, and should be carefully studied by the heads of all departments.

The mated stock passes to the stamper, where the dressing up is done according to the order of the customer. The sole and toe stamps, or stickers, placed on the foot, and the color combination of the riders lend much to the appearance of the hose.

Following the stamping, the goods are folded and boxed. The box plays an important part, and in a measure is an expression of the character of its contents.

The Use of Alkalies in the Textile Industry*

By W. E. Phillips

Technical Representative, Mathieson Alkali Works, Charlotte, N. C.

Without exception, alkalies find use in some form in every textile mill in the country. A clear understanding of the term "alkalies" is necessary to fully appreciate their value in the industry.

Technically speaking, alkalies are the hydroxides of sodium, potassium, lithium, caesium, rubidium and ammonia; fixed alkalies are the carbonates of the alkali metals, and volatile alka'ies, ammonia. However, to the mill man alkalies include caustic soda, soda ash and ammonia. The price of potassium hydroxide, which is a true alkali, prohibits its use in the textile industry.

*Presented at the winter meeting of the Piedmont Section of the American Association of Textile Chemists and Colorists, held in Greensboro, N. C., January 22, 1927.

Sodium carbonate or soda ash, as it is commonly known, holds the ranking position among the alkali group from the tonnage standpoint. The general quotation of producers refers to a material containing 58 per cent sodium oxide. Prior to June, 1923, it was a custom to quote prices according to the so-called "New York and Liverpool Test." According to this test, the prices were on a basis of 48 per cent of actual alkali content, but the method of computing the composition of soda ash from its chemical analysis was based on erroneous chemical equivalents which overstated the purity of the product. In 1923 this method of quoting, which had originated in England, was discarded, and domestic producers adopted the policy of quoting on a flat price based on the actual percentage of sodium oxide contained in the soda ash.

In marketing soda ash, the 58 per cent material is sold as 58 per cent light and 58 per cent dense. As the names indicate, the distinction is entirely one of density, the dense ash weighing about one-third more per unit than the light ash. The entire output goes to the glass industry.

The production of soda ash in this country is dominated by the ammonia-soda process. Briefly, the ammonia-soda process can be described in the following manner: Common salt or sodium chloride is dissolved in water and the solution saturated with ammonia gas. Carbon dioxide is then forced through the solution, precipitating sodium bicarbonate and leaving ammonium chloride in the residual liquor. Subsequent calcinating of the precipitated sodium bicarbonate decomposes it into sodium carbonate or soda ash, carbon dioxide and water, while ammonia is recovered from the liquor by treating the latter with lime produced in kilns which also yield the carbon dioxide required to precipitate the original brine.

"TABLE OF ASH"

DISTRIBUTION OF SODA ASH IN 1925

	Tons
Glass works	520,000
Caustic soda	465,000
Sundry chemicals	185,000
Soap	155,000
Sodium bicarbonate	100,000
Pulp and paper	75,000
Water softening	75,000
Textiles	35,000
Petroleum	25,000
Exports	16,000
Miscellaneous	59,000
	1,710,000

Soda ash is very largely employed as a detergent of textile fibers and, used in this way, acts more as an emulsifying than as a saponifying agent. This is due to the fact that soda ash will not combine with the glycerides of oils, fats and waxes, and forms sodium salts only with the organic acids.

Used in boiling out cotton in the proportions of ½ to 3 per cent, based on the dry weight of the goods, it proves an excellent detergent, although it is far more efficient when used in connection with caustic soda. Many manufacturers have found that the use of soda ash aids materially in the boil-out by passing the piece goods, on their way into the kier, through a warm solution containing soda ash of 1 deg. Be. This impregnates the cloth with soda ash, permits of a more regular loading into the kier, and succeeds in hydrolyzing whatever starch may be left in the goods.

Soda ash is used extensively in sulphur dyeing, where its purpose is of a twofold nature, namely: (1) To prevent the sulphide and dye from reacting to form an acid and (2) as a water softener. There seems to be conflicting views as to the use of caustic soda in sulphur dyeing, some claiming satisfactory results, the majority claiming dissatisfaction due to a bronzed effect of the finished material. Most dyers prefer playing safe, and use soda ash exclusively.

Within the past few years a decided change to sodium hypochlorite, prepared with liquid chlorine, has been witnessed through the entire South. With a possible exception of one or two mills, every mill in the South has adopted the use of liquid chlorine in preparing the chemic. This is due to the superior bleach, dependable finish and ease in preparation as compared with the old bleaching-powder method. Here soda ash plays an important part. Readily dissolving in water, it definitely "embraces" the liquid chlorine entering the solution and changes it into sodium hypochlorite, requiring three and one-half parts of soda ash to hold one part of chlorine. In the preparation of sodium hypochlorite, caustic soda is sometimes recommended, either with ash or alone. Caustic soda has a tendency of stabilizing a sodium hypochlorite solution and is used only in this capacity, as it also retards the action of the available chlorine in solution. Those mills that make up their chemic daily, or every two or three days, indorse the use of soda ash alone.

Because of its many uses a rigid analysis should be made of soda ash, and the presence of iron salts and free caustic, especially objectionable, should be of major importance in the purchase of this material.

Caustic soda, the common name of sodium hydroxide, is sold in the solid, the flake and the liquid form. It is of high alkali strength and sold on a basis of 76 per cent sodium oxide, although some caustic soda is marketed at 77 and 74 per cent sodium oxide content. Manufactured by the ammonia-soda and electrolytic processes, caustic soda ranks next to soda ash in tonnage. By the am-

monia-soda process, caustic soda is made by boiling soda ash with slaked lime. This process furnishes approximately 75 per cent of the caustic soda produced in the United States annually.

The electrolytic process involves the passing of an electric current through a solution of sodium chloride. Chlorine gas is evolved at the anode and the sodium ion reacts with water to liberate hydrogen gas at the cathode, forming caustic soda in the solution. Everyone knows the uses of liquid chlorine in the bleacheries, and practically the entire output of chlorine is manufactured by this method. The hydrogen gas from the cathode was for many years wasted by discharging into the atmosphere. Recently the Mathieson Alkali Works and one other company have been treating this hydrogen gas with atmospheric nitrogen to make ammonia by the Haber process.

The caustic soda is sold either as cell liquor containing approximately 25 per cent caustic soda or is evaporated and sold in liquid or solid form. In the manufacture of caustic soda, higher decomposition of efficiency than 50 per cent cannot, as is known, be attained if an economical current efficient is to be maintained. As a rule, it is most economical to work with about a 40 per cent decomposition efficiency. That is, the salt content of the original brine can only partially be converted into caustic soda while about half remains unchanged. This accounts for the trouble that many textile mills experience in the use of a low grade electrolytic caustic wherein pipes, kiers, pumps, etc., become clogged with salt.

The manufacture of rayon has opened a new field for caustic soda, and in 1925 the tonnage exceeded the use of caustic soda in all other textile fields as shown by this table:

CAUSTIC TABLE

DISTRIBUTION OF CAUSTIC SODA IN 1925

	Tons
Soap	110,000
Sundry chemicals	75,000
Lye	57,000
Petroleum	55,000
Export	50,000
Rayon	49,500
Other textiles	36,000
Rubber	16,000
Vegetable oil refining	14,500
Pulp and paper	9,000
Storage batteries	5,000
Miscellaneous	15,000
	492,000

The manufacture of rayon falls under one of four classifications:

1. The Viscose method (Cellulose Xanthate).
2. Tubize method (Nitro-Cellulose).
3. The Bemberg method (Cuprammonium).
4. Celanese method (Cellulose Acetate).

All four processes involve the use of caustic soda, although the viscose method probably uses more than the others, due to the fact that the raw material is converted into "alkali cellulose" by treatment of the linters or wood pulp with caustic soda of mercerizing strength for several hours. However, each process uses quantities of caustic soda, and the rapid growth of this industry is becoming a very vital factor in caustic soda consumption.

Caustic soda has many uses in the finishing plant, and in the dyehouse is essential to indigo and mineral dyeing. In the latter instance it is used as a reducing agent, and in hot solution of 3 to 8 per cent strength reduces the iron and chromium acetates to their oxides. Cotton printing consumes quantities of caustic soda.

In the boiling-out process higher efficiency and better results are obtained when a pure caustic soda is used. Because of its high alkali strength some bleachers prefer the use of caustic soda with soda ash, but others prefer the straight caustic. It is an extremely thorough agent and there are no oils, fats or waxes that are not saponified or emulsified in the kier by this alkali. In no other phase of the textile industry is the use of a high grade caustic soda so imperative. Impurities, such as iron and aluminum salts, do unlimited damage unless kept at a minimum. The purchaser of this material must discriminate keenly when buying to safeguard his finished product, especially at this stage. Naturally, it is a great reducing agent, and care should be taken to prevent the air from coming in contact with the goods when saturated in hot caustic soda solution as oxycellulose is formed, which is known to the bleacher as "tendered goods." According to Thies, a caustic soda solution of 1 to 2 per cent strength, even with air in the kier, has no injurious effects, although a caustic solution of 4 to 5 per cent strength under a similar condition has a weakening action on the cotton.

In the preparation of the chemic those bleacheries preparing their sodium hypochlorite weekly or semi-weekly prefer caustic soda, either with soda ash or alone, to hold the chlorine. During the hot months of the year this plan of preparation is especially indorsed. Caustic soda dissolves readily in water evolving much heat, and it is of prime importance that this solution be thoroughly cooled before the liquid chlorine is allowed to enter. In the preparation of sodium hypo-

chlorite the heat of reaction of the chlorine with caustic soda causes a rise in temperature of solution approximately 0.5 deg. Fahr. per one gram chlorine per liter. In a solution, therefore, containing 50 grams chlorine per liter, a rise of temperature of at least 25 deg. Fahr. from the initial stage may be expected. The final temperature of the solution should not exceed 90 to 95 deg. Fahr., as above this temperature decomposition of sodium hypochlorites into sodium hypochlorates begins with a corresponding loss of available chlorine. The success of the finished bleach is directly dependent upon this. Chlorine, in itself, is not a bleaching agent, but liberates oxygen directly in proportion to the amount of chlorine available. It requires 120 parts caustic soda or a mixture of 200 parts soda ash and 80 parts caustic soda to "hold" 100 parts of chlorine.

The process of mercerizing is one of the largest caustic consuming operations in the textile industry. The usual conditions of mercerizing are treatment of the material while under tension with the caustic soda solution of about 55 to 66 deg. Tw. for one to three minutes. The use of a stronger solution or a longer time does not increase the degree of mercerization. One pound of cotton yarn requires .66 to .75 pounds 76 per cent caustic soda. This is practically all removed by subsequent washing and can be partly reclaimed by evaporation.

Many faults in bleaching, boiling-out, dyeing, mercerizing and in the manufacture of rayon, especially by the nitro-cellulose and viscose method, are avoided by keeping an accurate check on the analysis of caustic soda. Not only is the sodium oxide content important, but the iron and aluminum salts, sodium chloride and sodium carbonate must be kept at a minimum, and purchasers of caustic soda cannot be too exacting for insisting upon an accurate analysis of this material before buying.

Ammonia is the only volatile alkali and because of this inherent characteristic, finds favor in many textile mills. It is of special value in mercerizing plants to neutralize the excess acid which was used in the role of neutralizing the caustic soda employed in mercerization. Being volatile there can never be an excess of ammonia on the yarn, and this, of course, lessens the danger of having a finished yarn impregnated with other alkalies or oils.

In the Bemberg rayon or the cuprammonium process, ammonia is an essential ingredient. This method of manufacturing rayon falls in the regenerated cellulose class and involves the dissolving of linters or wood pulp in an ammoniacal solution of copper, and the regeneration of the cellulose from this solution in the form of a thread. The common method of obtaining a proper solution of this type is accomplished by dissolving copper turnings in aqua ammonia. Aqua ammonia is the anhydrous ammonia gas dissolved in distilled water, the final solution containing 29.4 per cent NH_3.

Under the class of modified or textile sodas fall those compounds which are mechanical mixtures of caustic soda, soda ash, bicarbonate of soda, borax and trisodium phosphate in various proportions. These compounds may be used in the dyehouse and bleachery, but must follow the law of chemistry which controls the use of all alkalies; namely, that the use of alkalies is directly based upon the sodium oxide content.

Indigo Dye*

By Joseph P. Jaeck

Dyestuffs Department, E. I. du Pont de Nemours & Co.

A few days ago as I was paying a visit to the Charlotte office of the Du Pont Company, I had the pleasure to be informed by John L. Dabbs, whom you all know very well, that I had been slated to address you gentlemen this evening and that the subject chosen was Indigo. The proposition certainly did flatter me, and after a few minutes of hesitation I informed Mr. Dabbs that I would do my best to keep your attention for a few moments on a product which is as universally known and used as Indigo.

There is no doubt that you are all more or less acquainted with this color, and quite a few assembled here have handled thousands of pounds of Indigo, both natural and synthetic.

Before going into the details of the application of Indigo in the textile industry, I must say a few words relating to the past history of this color.

When the word Indigo is mentioned to any one of you gentlemen, it is natural that your mind should take you back thirty years and cause you to think of the vegetable color which was then extracted from the leaves of the plant known as "Indigofera," and which is now synthetically produced on such a tremendous scale.

Indigo in History

To go beyond the Christian era, history tells us that Indigo has not only been known, but has been the favorite blue dye for thousands of years. It was used centuries ago by the Egyptians, Greeks and Romans; in fact, wherever the Indigo plant was found. Whether the plant from which Indigo was extracted had been grown in Egypt or came from Asia no one knows. The exact method of application of the color on the fiber in those ancient

*Presented at the winter meeting of the Piedmont Section of the American Association of Textile Chemists and Colorists, held in Greensboro, N. C., January 22, 1927.

times is not known to us, but we have all reasons to believe that the same method of dyeing was applied as the one now used by the natives of the countries where Indigo was grown, that is, the fermentation process.

Natural Indigo has been grown in India, China, Java, Mexico, Brazil, Guatemala and Haiti. According to the methods used to gather the crop, the degree of purity varied considerably. It ran from 80 per cent for Java Indigo down to 30 per cent for Guatemala or Mexican Indigo.

Practically every dyer is acquainted with the various transformations which have taken place in the production, the marketing and the application of Indigo during the last thirty years.

Until the latter part of the nineteenth century very little was accomplished to determine the exact composition of Indigo. In the late seventies Dr. A. Baeyer worked out the composition and several methods for the synthetic formation of Indigotine, and while the processes now in use by the manufacturers of synthetic Indigo are not entirely the discovery of Dr. Baeyer, all the credit of founding this important industry of Indigo manufacture should be given to him. To Dr. Baeyer's untiring energy is due the commercial production of Indigo at a price low enough to compete with natural Indigo, and with a few exceptions the elimination of the latter almost completely from the textile industry.

I may say that the Badische Aniline and the Farbwerke-Hoechst, after endless study and research, carried out over many years with undiminished zeal and at a tremendous sacrifice of money which ran into the millions at least, succeeded in perfecting the process for the manufacture of synthetic Indigo.

If I remember correctly, in 1896 or 1897, the two large German aniline dye works, the Badische Aniline and the Farbwerke-Hoechst, agreed to work jointly the processes of Dr. Baeyer and exploit the one perfected by the other chemists, such as Dr. Heumann and J. Pfleger.

Synthetic vs. Natural

It is a well-known fact that in 1913-1914, when production had been established upon a paying basis, the synthetic Indigo had almost driven the natural product from the world markets, not only on account of lower cost, but because it was purer, a more reliable product, and its method of application simpler. In 1913 Germany's export of this dye had reached 74,000,000 pounds, and the imports of synthetic Indigo into the United States amounted to 8,500,000 pounds. The price had dropped in ten years from 40 cents to an average of 15 cents per pound. Indigo, the coloring matter manufactured from coal-tar intermediates, is identical in every respect with the natural Indigo and should not be in any way considered different from the latter. It shows the same general properties, the only difference existing between natural and synthetic Indigo being that of appearance. Synthetic Indigo is usually marketed in the form of a 20 per cent paste or a finely ground powder. The opposition and prejudice which at first induced many dyers to continue using the vegetable dyestuff has entirely disappeared.

In addition to the two German firms, it is well to mention that John R. Geigy & Co. in Switzerland had also manufactured synthetic Indigo on a commercial scale in 1902, but for reasons which have never been fully explained discontinued it shortly afterward. Later on, in 1911, the Chemical Industry of Basle entered the field, and is still a large and successful producer of this color. These were the only independent producers outside Germany prior to the war, although certain branch factories of the German producers had been established in France, and a small amount of the color was also manufactured in England.

When the blockade established by the Allies on German commerce in 1914 had shut off the German Indigo, except for a few thousand pounds landed in New York, New London and Baltimore by the chartered steamship "Matanzas" and the submarine "Deutschland," the textile industry to its sorrow had to return for a while to the use of natural Indigo. This Indigo, as formerly, came from India, Java, and South America. These countries did a land office business while the war lasted, and I am sure that quite a few mill owners will remember for a long time the quality and the price they had to pay for Indigo in these days of the war. The exhaustion of the existing supplies of Indigo, together with the continuance of the war, clearly indicated the necessity of a home dye industry as a source of supply.

American Manufacture of Indigo

It was certainly a great relief to the American consumers when the dyestuffs manufacturers of this country realized that it would be a distinct advantage to have an independent source of supply of synthetic Indigo and commenced work on the problems of this important dyestuff. After large investment of money in equipment and difficult research work, the United States was the first nation outside of Germany and Switzerland to produce Indigo successfully on a commercial scale.

Synthetic Indigo was made by the Dow Chemical Company in its plant at Midland, Mich., in the latter part of 1916, and from the earliest production has been very satisfactory to the textile trade. Since then the capacity of the plant has been largely extended.

In the following year, October, 1917, the Du Pont Company started the production of Indigo. In the early part of 1918, this product was manufactured at Deep

Water plant, N. J., and delivered to the mills in sufficiently large quantities to relieve to a certain extent the shortage. This performance was accomplished exclusively by American engineers and chemists of the Du Pont Company. Finally, late in 1918, a third concern, the National Aniline & Chemical Company, entered the field. To-day, this country has extended the manufacture of Indigo to such a degree that it is safe to assume it could very nearly supply the whole world with this article if such a necessity arose.

Without going into detailed technicalities and complex reactions, you may be interested to know the main constituents which are used to-day in the manufacture of synthetic Indigo. Starting with aniline oil and sodium cyanide, phenylglycine is made and fused with caustic soda and caustic potash in presence of sodamide which produres Indoxyl. Upon drowning this fusion and blowing air through it, Indigo precipitates, and after filtering and washing the color is made into a 20 per cent paste or powder as required.

For the past eight years the extensive use of synthetic Indigo in this country has also been assisted by a continual reduction in price consequent with the improvements in the manufacture. This quantity production and reduction has also had the effect of making this country absolutely independent of the pre-war source of supply and the shutting out of foreign importations.

In former years the Indigo dyers had to accept the natural product just as it was and the result would vary according to the quality and purity of the vegetable color. Nowadays, Indigo is delivered to the same dyers in the form most suited to their work and they are kept informed as to the best processes of application.

Whether derived from the plant or manufactured synthetically, all methods of dyeing with Indigo depend upon the reductions first of the Indigo Blue to Indigo White, and after the latter has been absorbed by the fiber, its reoxidation to Indigo Blue.

The conversion of Indigo Blue to Indigo White can be carried out in various ways and five different kinds of vats, as they are termed, are to be distinguished.

The Various Indigo Vats

The oldest method is by fermentation and this requires the use of various ferments and substances capable of fermentation with Indigo. The ingredients used in the fermentation vats vary, but substances which ferment easily in alkaline solutions are always used. Among these are bran, flour, molasses. Most of these, however, are things of the past in all countries except India, Japan and China, where the natives still depend on this method of Indigo dyeing, due to the fact that the ingredients used are reasonably cheap, easily obtained, and give the so-called "Indigo odor" to the dyed material, which in some markets is absolutely necessary.

Indigo dyers have used, and have discarded successively as progress has been made in the art of dyeing, the copperas vat, the zinc and lime vat, the zinc bisulphite vat and finally adopted the hydrosulphite vat, which is now used exclusively on cotton and wool.

On cotton, which is dyed cold, the working of the zinc and lime vat depended upon the property of zinc dust to react with slaked lime, forming calcium zincate and hydrogen. In using a vat of this type dyers had to be very careful of the amount of reducing agent used, otherwise they would not obtain a sufficient reduction of the Indigo; or again, the reaction would be too violent and the dye vat would foam over, losing a great percentage of the Indigo.

The same difficulties were encountered when the copperas vats were in use. Ferrous sulphate and slaked lime were employed as reducing agents. The copperas-lime reduction always results in a considerable loss of dyestuff. It was very seldom that the loss fell below 20 per cent. A further disadvantage of the zinc lime and copperas vat was the large quantity of sediment, this rendering the continuous replenishment of the vat nearly impossible.

It was in 1884 that real progress in Indigo dyeing was noticed, and this was brought about when Schutzenberger and Lalande recommended sodium hydrosulphite for reducing Indigo. It did not take very long for the dye industry in general and the Indigo dyers in particular to grasp the advantages of the hydrosulphite vat.

The hydrosulphite vat may be prepared either with lime or caustic soda. When first in use, and, in fact, until very recently, the hydrosulphite or bisulphite, zinc and caustic soda were made into a concentrated solution with Indigo. The common practice was to add to the Indigo already in the paste form a certain amount of bisulphite and zinc; then in about a quarter of an hour, when the mixture had lost its sulphurous acid smell and had assumed a light grayish green color, lime or caustic soda solution was added. In dyeing, the vats were filled with cold water with a small quantity of the mixture of bisulphite and zinc dust and caustic soda. The necessary amount of reduced Indigo, according to shade, was then added, the vats well stirred and then allowed to stand long enough to allow insoluble matters to settle.

From the original bisulphite caustic vat, it was only a step to separate or filtrate the sludge formed by these chemicals and use only the clear solution from it known as hydrosulphite liquid. This hydrosulphite solution is always used as soon as possible and is taken to reduce the Indigo in concentrated form or keep the vats in a reduced condition.

To simplify the handling of synthetic Indigo, the Badishe and Farbwerke-Hoechst had been working on and finally had placed on the market in 1906 or 1907 a product known as hydrosulphite conc. powder. This product being free of water, was reasonably stable when exposed to the influence of air and gave entire satisfaction to the users from the beginning.

Hydrosulphite Powder

Being an important adjunct to the dyeing of cotton and wool with Indigo, it is well to mention that two American firms have taken up the manufacture of hydrosulphite powder on a large scale, and there is no doubt that the quality of their product is equal in every respect to that made by the German factories. This is another feather in the cap of our chemists.

The combination of synthetic Indigo and hydrosulphite powder is an ideal one and in fact has influenced and enlarged the field of Indigo dyeing to a great extent. In former years the Indigo dyeing equipment of the average cotton mill was very crude; it consisted mostly of single units, and required a large amount of hand labor. The mill owners also were more or less at the mercy of the boss dyer. In the old days, when fermentation vats were in use an Indigo dyer was always suspected of being a sort of magician, as he could make a healthy Indigo vat sick at will, and vice versa.

Since cotton skein dyeing by hand has disappeared completely, and the adoption of long chain dyeing, the largest consumers of synthetic Indigo in the present day are the denim manufacturers. With their new dyeing equipment, they are able to obtain uniformity of color, depth of shade, and quantity production, which are now essential, but were considered almost impossible a few years ago.

An up-to-date dyeing equipment boils out the yarn, cools it off and carries the warps single-stranded fashion, varying in number from 8 to 20, through a succession of vats or dips with skying frames between. When the shade has been reached through a sufficient number of dips, the yarn is rinsed, dried, and made ready for the beamers. It is, of course, of the utmost importance to feed into the vats a sufficient amount of reduced Indigo and hydrosulphite in order to have the dye bath at the end of the day's work in the same condition as when the day's work began. This, of course, is not what I would call a foolproof method and requires some adjustment and attention on the part of the dyer.

Development of Cotton Piece Work

Cotton piece dyeing with Indigo is also an important branch of the dye-consuming industry, but for some reasons the demand for this class of goods is not as large as it was five or six years ago. Dyeing in the piece is carried out for the production of plain blue goods and for discharge work. Discharge printing on Indigo consists of the destruction of the dyestuffs by oxidation. The most important discharging agents for Indigo are chromates and chlorates. It has been found that formaldehyde sulphoxylate with the addition of anthraquinone, zinc oxide and acetin reduces Indigo on steaming and forms an Indigo White compound which can be removed from the cloth by pressing the goods soon after steaming through a hot caustic soda solution or a 1 per cent solution of silicate of soda at the boil.

Early in 1910 the Badische Aniline brought out an improved method of discharging Indigo-dyed fabrics with the introduction of the leucotropes and placed on the market two products suitable for the purpose, namely, Leucotrope W and Leucotrope O. The stability of both in moist or dry air dispenses with the necessity of washing the printed goods in alkali soon after steaming. The leucotrope hydrosulphite discharges have the great advantage to discharge the deepest shades of Indigo to a pure white without any fear of tendering the cloth to the slightest degree.

The dyeing of cotton piece goods by the continuous process is very much the same as the one used on long chain warps and vats of smaller dimensions may be used. The removal of the size from the goods is an important operation. The shade is obtained through a succession of dips with J boxes or skying frames to allow the Indigo to oxidize thoroughly between each succeeding dip. The rinsing, drying and finishing are usually carried out on separate equipment. The direct fixation or printing of Indigo on cotton fabrics is resorted to for certain patterns and classes of goods.

The most important methods are the glucose printing and the formaldehyde sulphoxylate. Both methods are characterized by the use of strong alkaline solutions. The complete reduction of the Indigo and subsequent fixation upon the fiber is brought about in an ager free from air

Next in importance to the recent improvements brought about in the dyeing of long chain warps and cotton piece goods with synthetic Indigo, it is well to mention some other methods which have been made possible by the use of dyeing machines of the circulating type. Several of these are in use, the principles are about the same for all of them and they are giving satisfactory results up to a certain point. There is no doubt that under certain conditions the dyeings obtained with a dyeing machine of the circulating type display a perfect penetration of the color into the fiber, but for obvious reasons the depth of shade is confined to light and medium range.

From time to time the dyeing of loose cotton with Indigo has been attempted, but has never given satisfactory results. The difficulties encountered are not so much

in the dyeing or subsequent oxidation of the color, but in the handling of the fiber through the mill. The few experiments which have been made on several occasions have proved that the cotton, being oversaturated with Indigo, would lay on the cards and so could not be handled economically.

When anyone mentions Indigo, he always associates the use of this color with the manufacturers of denims, tickings, chambrays, awnings and the gingham industry. In fact, there is no doubt that nearly 85 per cent of the Indigo used in this country finds its way to the cotton mills. It may be news to you to know that the number of woolen mills which are making a specialty of Indigo-dyed fabrics could be counted on the tips of your fingers. However, it should be remembered that a good many men in the Navy, on the police force, as well as firemen, railroad men and letter carriers, are wearing material which has been dyed with Indigo.

Indigo on Wool

Although a certain quantity of wool has in the past been dyed in the piece, yarn or slubbing, this fiber is now dyed entirely in the loose state. Until quite recently fermentation vats were still in favor and the substances used in the preparation of these vats were, besides Indigo, bran, madder, woad and lime. The fermentation in these vats takes place at 125 deg. Fahr., and is accelerated or checked by the addition of bran or lime.

These vats, which ranged in size between 2,000 and 3,000 gallons, in order to leave room for the sediment, had a very limited production and required a great deal of care and attention on the part of the dyers. The labor attached to the handling of the wool was also very high. Therefore, with one or two exceptions, the fermentation vat has been replaced by the hydrosulphite vat, used in connection with synthetic Indigo.

The hydrosulphite vat, sometimes called by the dyer a chemical vat, is more compact, more easily managed and is not liable to get out of order. A single hydro vat of 700 to 800 gallons capacity is able to take care of the production of a dozen fermentation vats. Due to certain mechanical improvements, a much greater amount of work can be done in a given time, since it is not necessary to wait for the fermentation to take place or for the sediment to settle.

For the proper working of the wool to be dyed with the fermentation vat, various mechanical appliances are necessary. Formerly loose wool had to be suspended in a net in the dye bath, and after the requisite time of immersion the net had to be wound up on a pole on the top of the vat, thus saving the excess of dye bath which drained into the vat. In the present Indigo dyehouse this operation is performed mechanically with a dye tub of small dimensions equipped with a perforated copper basket to which is attached a pair of squeeze rollers. One or two dips of eight to ten minutes each are sufficient to obtain the desired depth of shade.

With the reduced size of the dye tub, new appliances and improved method of dyeing Indigo, the wool is in better shape and handed to the carding room in a cleaner condition than heretofore.

For the convenience of the wool dyers, Indigo vat, or Indigo in a reduced state, which does not require previous reducing, may be added to the hydrosulphite vat, thus saving both time and labor. The ordinary hydrosulphite vat for wool, unless prepared with care, may easily become too strongly alkaline and so cause excessive crocking as well as prove injurious to the fiber. The necessary alkalinity is therefore obtained by the addition of ammonia. Glue is also added to prevent the precipitation of Indigo White when the hydrosulphite develops acid by the action of the air.

While I am on the subject of wool dyeing with Indigo, I should not forget to mention the role played by this color when put through the process of sulphonation and used as an acid dye on wool or silk. Until 1887 or 1888 Indigo Extract, Indigo Carmine and Indigotine were extensively used in the carpet and worsted industry as the blue component for mixed shades or navy blues. As it was not very fast to light or fulling, this color soon lost out when the dyestuffs manufacturers were able to place in the hands of the dyers substitutes such as various brands of Patent Blues which were faster, brighter and just as easy to handle as Indigotine.

As I am about to end this short talk on Indigo I believe that it is safe to state that of all dyestuffs used by the textile industry, Indigo has been and will continue to be the one used to the largest extent. As a blue it has a very peculiar shade and tone in all depths, which is difficult to duplicate by any single color or combination. There is no doubt that Indigo washes off considerably and rubs off badly in the heavy shades. This serious problem to increase the fastness to rubbing of this color on cotton has been studied by several mills but without important results up to the present time. It is evident that the Indigo consumers could use certain blue dyestuffs of the vat family which are superior to Indigo in fastness, but none of these are able, up to the present time, to compete to any extent in cost or ease of application. No other color has been subjected to imitation as much as Indigo, and it seems that it will remain for some time to come as the undisputed standard color for blues.

JANUARY MEETING OF THE RHODE ISLAND SECTION

The January meeting of the Rhode Island Section of the American Association of Textile Chemists and Color-

ists was held in the rooms of the Providence Engineering Society on Friday evening, January 21, 1927, at 8 o'clock.

The speakers were Daniel P. Knowland, textile chemist of the Geigy Company, and William H. Cady, research chemist of Pacific Mills.

Mr. Knowland delivered an interesting paper upon the "Application of Chrome Colors in Wool Dyeing," referring particularly to Erio-Chrome colors. His paper will be published in full in the next issue of the Proceedings.

Mr. Cady gave a very interesting resumé of the work done by the Subcommittee on Light Fastness and exhibited samples to illustrate his talk.

A rising vote of thanks was given to the speakers of the evening and the meeting adjourned at 10.15. Thirty-four members were present.

A. N. DANA, *Secretary.*

FEBRUARY MEETING OF THE RHODE ISLAND SECTION

The February meeting of the Rhode Island Section of the American Association of Textile Chemists and Colorists was held at the Turks Head Club, Providence, on Friday evening, February 11, 1927.

The meeting was preceded by a dinner at 6.30 o'clock, at which thirty-six members were present. A short business meeting followed the dinner, Chairman Williams presiding. Owing to the absence of the Secretary, the reading of the minutes of the previous meeting was omitted.

The nominations having been made by the Nominating Committee, the following officers were elected for the year 1927: John Hutton, Chairman; Ben Verity, Treasurer, and Albro N. Dana, Secretary.

Then followed an interesting talk by Mr. Williams on "Continuous Boiling and Bleaching."

The Sectional Committee comprises: Herbert F. Schwarz, Karl R. Moore, John S. Masson and Wm. H. Wingate.

A. N. DANA, *Secretary.*

JANUARY MEETING OF THE PHILADELPHIA SECTION

The regular January meeting of the Philadelphia Section of the American Association of Textile Chemists and Colorists was held in Philadelphia on Friday evening, January 28, 1927.

At 6.15 p. m. ten of the members sat down to the usual informal dinner at the City Club of Philadelphia.

The meeting was called to order by Chairman W. R. MacIntyre in the Student Clubroom of the Philadelphia Textile School at 8.30 p. m.

Minutes of the previous meeting were read and approved.

Chairman MacIntyre then announced the Program Committee for the year 1927 as follows: Chas. E. Mullin, Chairman, Dr. R. E. Rose, E. C. Bertolet, L. A. Stead, H. A. Stafford, C. F. Goldthwait.

There being no further business the Chairman then introduced A. A. Cook, of the United States Testing Company, of New York, who addressed the Section on the subject of "The Testing House and Its Relation to the Industry."

Following a brief discussion of the paper, a motion for a vote of thanks to the speaker was made and passed, and the meeting adjourned at 10 p. m.

There were twenty-eight present.

PERCIVAL THEEL, *Secretary.*

FEBRUARY MEETING OF THE PHILADELPHIA SECTION

The regular February meeting of the Philadelphia Section of the American Association of Textile Chemists and Colorists was held in Philadelphia on Friday evening, February 25.

At 6.15 p. m. sixteen members and guests sat down to the informal dinner, which precedes the meeting, at the City Club of Philadelphia.

At 8.30 p. m. Chairman Wm. R. MacIntyre called the meeting proper to order in the Student Clubroom of the Philadelphia Textile School.

The minutes of the January meeting were read and approved.

Charles E. Mullin, chairman of the Program Committee, reported that for the March meeting it was expected to have an address by Dr. Wm. Stericke, of the Philadelphia Quartz Company, on the subject of Doucil. For the April meeting arrangement was made for an address on Hydrogen Ion control.

There being no further business, the Chairman introduced the speaker, R. W. Marsson, of the General Dyestuff Corporation, of New York, who gave a most interesting and instructive address on the subject of "A Visit to the Naphthol Dyehouse and Some Problems of the Dyer." After a brief formal discussion of the paper a rising vote of thanks was tendered the speaker, and the meeting adjourned at 10 p. m. to break up in a number of informal group discussions of the paper.

There were forty-seven present at the meeting.

PERCIVAL THEEL, *Secretary.*

SPRING MEETING OF THE SOUTHERN SECTION

The Piedmont Section of the American Association of Textile Chemists and Colorists will hold its spring meeting at the Poinsett Hotel in Greenville, S. C., on April 16.

The technical program for this meeting is not yet complete, but it will include papers on "Package Dyeing in Closed Machines," "The Dyeing of Multi-Fibered Hosiery" and a discussion of some phase of piece goods dyeing.

A committee of Greenville members of the section promise to include something unique in the way of entertainment on the program of this spring meeting.

Correction in "Physical Tests to Determine the Effects of Chemical or Other Treatments on Yarns"

In the paper by Charles F. Goldthwait published under the above heading in the January 10 issue of the Proceedings, the "4 per cent" just above the table at the foot of the first column on page 11 should read 45 per cent. Also the figures for "Difference, relative" in tables on pages 10 and 11 should be followed by the per cent sign which was omitted in printing. These values are, of course, not pounds as at present implied.

The skeins in the next to the last paragraph of the article were wound instead of "found" on the 54-inch warp reel.

An additional note might be made that the most recent work, some of which has appeared since the above article was written, indicates that the breaking of cotton yarn may be due more to actual breakage of fibers and relatively less to slippage than is implied on page 8, which reflects earlier views on the subject.

Applicant for Membership

Junior Membership

Rusticus, Theodore, hosiery dyer, National Silk Dyeing Company, Paterson, N. J. Sponsors: Edward Bohl, Jr., and Walter C. Hass.

Deceased

Powell, John G., 118 May Street, Hawthorne, N. J.
Scheuer, J. B., Southern Bleachery, Greenville, S. C.

ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

WALTER E. HADLEY,
5 Mountain Avenue,
Maplewood, N. J.

NEW TYPE OF DYE DEVELOPED BY BRITISH RESEARCH CHEMIST

Development of a new dyestuff, the process for which is said to be extremely simple and unlike any other method of dyeing, has been announced by the British Dyestuffs Corporation as a discovery of its research chemist.

In the method used for this dye, the color is first made to form a film on the surface of the material, and then, either immediately or during the dyeing process, it eats its way into the material and dyes it.

While its chief purpose will be for dyeing fabrics, other substances can also be similarly treated. Among others, the following substances have been found to yield excellent results with the process: Paper, straw, leather, cork, rubber, silk, rayon, cotton, pottery and wood. The most effective results are obtained with celluloid.

The new dye will be placed on the market this year, probably for summer goods.

STAIN REMOVAL IN DRY CLEANING STUDIED AT STANDARDS' BUREAU

Due to difficulty experienced by the dry-cleaning industry in removing mercurochrome stains from clothing, the Bureau of Standards has completed a study of this antiseptic which now is being used instead of iodine, and determined the manner in which such stains can be removed.

Working in co-operation with the research associate maintained by the dry-cleaning industry at the bureau, it has just been announced, it has been found that fresh mercurochrome stains may be removed from silk material by the application of certain chemicals.

The full text of a statement by the bureau, describing the cleaning process, follows:

Study of Processes

The dry-cleaning industry, through its research associateship at the bureau, endeavors to familiarize itself with the cleaning processes necessary to remove materials that are used in the household and are accidentally spilled on clothing. Some difficulty has been experienced in removing mercurochrome, an antiseptic now being used in many households instead of iodine. This product contains mercury in combination with an eosine type of dyestuff.

It has been found that fresh mercurochrome stains may be removed from silk material by first applying benzaldehyde, allowing it to stand for a few minutes, and repeating the application, then applying a 25 per cent solution of hydrochloric acid. It is well to follow this treatment by sponging with alcohol and then freely with water.

Some cleaners have found that an application of glacial acetic acid to the fresh stain is fairly effective. When only partially effective, this must later be treated with ether.

The dry cleaners must be particularly careful that this stain be removed when it is fresh, because mercury in solution when encountering sulphur becomes mercuric sulphide, which is black in color, and this black stain is insoluble and cannot be removed from the fabric. Sulphur may be encountered in the dry-cleaning plant either from traces contained in some of the cleaning solvents or from free sulphur in the air resulting from materials used in the cleaning of hats or in the form of gas from the boiler, etc.

SURFACE TENSION OF LIQUIDS STUDIED

Bureau of Standards Issues Treatise

A paper on the measurement of surface tension of liquids, prepared by Dr. N. Ernest Dorsey, consulting physicist of the Bureau of Standards, has just been issued by the Department of Commerce. The study, according to the abstract of its text, is described as follows:

"This paper (a) presents a brief survey of the more important of the methods which have been employed in the measurement of surface tension, (b) calls attention to some of the more important facts which must be kept in mind by one wishing to succeed in such measurements, (c) indicates certain errors which are frequently made and shows how they may be avoided, and (d) gives the working equations that are applicable to the methods considered. A bibliography of more than 100 selected papers is appended. In each instance the purpose for which the reference was selected is indicated."

In the past, surface-tension measurements have frequently been marked by excessive care to secure a high reproducibility, accompanied by scant attention to the possible presence of constant errors and to the real significance of the quantity which is reproduced. There is a great need for a careful study of the various methods, in order to determine (a) the proper interpretation of the quantity which is determined by each, (b) the magnitude of the errors which are introduced by known small departures from the ideal conditions upon which the interpretation rests, and (c) the limits within which each of the several methods are trustworthy.

The object of the present paper is to present a brief survey of the more important of the methods which have been employed, to call attention to some of the more important facts which must be kept in mind by one wishing to succeed in such measurements, to indicate certain errors which are frequently made and to show how they may be avoided, and to give the working equations that are applicable to the methods which are here considered. The derivations of the equations and directions for the construction and use of the necessary apparatus will have to be sought in other places, to the more important of which references will be given.

PRESENT EXTENT OF JAPANESE DYESTUFF INDUSTRY

The following information covering dyestuffs and intermediates now being manufactured in Japan in commercial quantities has been compiled from the best available information and is believed to be accurate and complete to date.

There are two large and active producing concerns, the remainder are small, mostly having capitalizations of from $10,000 to $50,000.

Fourteen factories produce sixteen acid colors.
Ten factories produce five basic colors.
Three factories produce sixteen chrome colors.
Three factories produce eighteen direct colors.
Thirteen factories produce fifteen sulphur colors.
Two factories produce nine oil and lake colors.
One factory produces six alizarine colors.
Two factories produce one vat color.
Two factories produce five phthalein pinks.
One factory produces two textile intermediate colors.
Six factories produce nine intermediates.

The names of manufacturers and colors available in the U. S. Bureau of Foreign and Domestic Commerce to interested firms. The above information was supplied in a dispatch to the Department of Commerce from Consul E. R. Dickover, of Kobe, Japan.

At the end of the last fiscal year the Japanese Government had paid 14,000,000 yen in grants on dyestuffs manufactured by the Nippon Dyestuff Company, which was thus enabled to pay a dividend of 8 per cent per annum on its invested capital. A short while ago modifications were introduced into the Government's protective measure and on twenty dyestuffs designated that 4,000,000 yen be paid, spread over five years.

Of these twenty the Nippon Dyestuff Company has succeeded in producing seven, and on these subsidies grants are paid. Criticism is directed to the Commerce Department, which is alleged to be inspired by favoritism in paying grants. It is pointed out, says the Japanese press, that the Nippon Senryo Kaisha is qualified financially and in other respects to experiment and produce those dyestuffs, but difficulty arises when there are two companies which produce the same material calling for grants.

According to the Yushin Nippo, the Japanese Commerce Department attaches little importance to the question and says that preference will be given to the producer whose financial strength insures the regular production of the dye in question. But the question is not one to be settled so easily, says the Japan Chronicle, which points out that, "Recently another company has succeeded in producing a dyestuff which is turned out under grants by the Nippon Senryo Company.

"The other company lays claim to a subsidy grant, declaring that from the military standpoint its process is more important than that followed by the Nippon Senryo Kaisha, and the Army Department is reported to be supporting the claim. When introducing the bill for modifications in the protection program, the Commerce Department laid down the principle that a grant on one item should not be shared by two or more producers. But as the protection is given not only from the industrial standpoint but also from the military, the Commerce Department is not in a position to act on the principle and rejects the application for grants in this case. It is reasonable to expect that the same situation will be faced frequently in the future. The only way of escape from the dilemma for the Commerce Department will be to recognize exceptions from the general rule."

The negotiations with Germany with regard to the importation of dyestuffs are understood to be progressing satisfactorily, so that a final arrangement will be effected in a few weeks. The German Embassy has handed to the Japanese foreign office, it is reported, a list of dyestuffs on which agreement is to be reached before establishing the new tariff schedule.

German-Japanese Chemical and Dye Agreement

From unofficial sources a report states that Germany's position in regard to the Japanese market is improving as a result of the agreement of the German chemical industry with the Japanese Government allowing the entry of German dyestuffs under the same conditions as are placed upon the entry of products from other countries. The I. G. Farbenindustrie has an understanding with the Daido Dyestuffs Company whereby the sole agency for German dyes is given to the Japanese company. It is probable, however, that a further agreement will be reached with the well-known Mitsui company. German and Japanese dyestuff producers have been negotiating for some time in regard to an arrangement which might allow Germany a share in profits in exchange for expert aid and the use of protected processes. It is alleged that the Japanese are very much inclined toward such an understanding, in view of complaints from Japanese textile manufacturers concerning the quality of dyes in the Japanese market. When it is considered that the Vereinigte Glanzstoff Fabriken is said to have a strong interest in one of the largest artificial silk companies of Japan and synthetic nitrogen will be produced and sold there according to the Haber-Bosch process with the aid of German chemists, an understanding in regard to dyestuff manufacture appears to be merely a further step toward the co-operation of the German and Japanese chemical industries.

As in other producing countries, Japan's acreage and production of indigo is yielding to the competition of the synthetic dye.

In 1923, 9,783 acres yielded 14,080,138 pounds, and in 1924, 5,535 acres yielded 9,688,818 pounds.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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DYES IN MEDICAL RESEARCH

CHEMISTRY presents the perfect example of a unified science, because of the close relation that exists between its various divisions. As a matter of fact, these divisions have been artificially set up by man for convenience; actually, chemistry is an intimately organized whole, its parts interacting and reacting upon each other, exactly as the parts of the human body affect and depend upon each other in carrying out their individual functions. We see around us countless illustrations of this unity wherever the knowledge gathered by one branch of chemistry is applied in another branch.

Even the layman knows now that the products of coal tar, when combined with apparently unrelated substances of inorganic or animal nature, have made possible many new drugs and medicinals. The world has come to accept the view that the creation of these new compounds, and of the colors and perfumes we use, is chemistry's way of repaying for the dreadful work it does when in the form of war munitions. With no intent to disparage the chemist's work, we may think of it as possessing a Jekyll-Hyde character.

The bond that joins medical science to the broader science of organic chemistry becomes even more distinct when we learn how dyes are used in the treatment of blood poisoning and in the study of the action of oxygen in living cells. The outline of this story of dyes in the service of the physiologist is sketched in the brief report, appearing elsewhere in this issue, from the Bureau of Public Health, Division of Chemistry.

The important studies made at the Government Bureau form but a fractional part of the research in so-called "chemotherapy" that is now being carried out in medical laboratories and institutes in this country. Experiments with dyes in treating blood poisoning were the subject of an address made recently before the American Chemical Society by Dr. John W. Churchman, professor of experimental therapeutics in Cornell University Medical College. Genetian Violet and other aniline colors were used in preventing the growth of diptheria bacillus in wounds, according to this authority, with a success that gave but a hint of the possibilities still to be uncovered in this obscure field. "In the struggle to put the treatment of infection on a sound and scientific basis," Dr. Churchman declared, "investigation of bactericidal properties of the aniline dyes has played an important part."

Of far-reaching influence in this class of research has been the outstanding work of Professor Erlich of the Royal Prussian Institution for Experimental Therapeutics at Frankfurt. Writing of this work in "Medical Research and Education," George J. Schultz said:

> Nothing can detract from the magnificent service by which Erlich and his pupils have benefited humanity and added to the glory of medical science by establishing the principle of specific chemotherapy. With a record of about a dozen drugs which can be used to cure or modify diseases caused by nearly a dozen different protozoa, chemotherapy offers promises of results which, with serum therapy and vaccination in bacterial diseases, will sharply limit the ravages of the transmissible diseases of man and animals. The new drugs are are follows: I. Arsenic group: arsenous acid, atoxeyl, etc.; II. Azo dyestuffs: Trypan Red, Trypan Blue and Trypan Violet; III. Basic triphenylmethane dyestuffs: Parafuchsin, Methyl Violet and Pyronin.

While studies of this nature constitute pure science research, that is, research for its own sake without any practical objective, we may easily suppose that it depends to a large extent on previous *industrial* research in dye chemistry. The chemist in the dye plant tracing the steps in the development of a new vat color, for instance, may unwittingly get a result that will later be of the highest value in medical research. The physiologist, in turn, has taught the dye manufacturer a few things about the properties of dyes.

Centuries ago the physician worked hand in glove with the chemist in combating human ills and ailments, but as civilization grew more complex, medicine and chemistry drifted apart, the chemist seeking greater rewards in the service of industry. Now the cycle is swinging the other way, modern physiology and medicine are coming with their problems to organic chemistry, thus giving proof of the fundamental nature of this science which underlies so much of life to-day.

Finally, we must keep in mind the fact that there could be little co-operation between medicine and organic chemistry in the United States to-day if we had not, nine years ago, laid the foundation for the development of a synthetic organic chemical industry by establishing a dye industry, from which have come so many of the products

used in medical research. Our research workers are able to render far more effective service because the source of their supplies is under domestic control and because they can feel assured that the American industry is always ready to offer its facilities in co-operation.

INDUSTRIAL ACTIVITY IN UNITED STATES BREAKS RECORD

During the last three months of 1926 there was a slowing down of industrial activity, and in December the output of industry was smaller than a year earlier. For the year 1926 as a whole, however, the level of production was higher than for any earlier year.

Industrial production, which includes both factories and mines, was about four per cent larger in 1926 than in 1925, owing partly to an increase of about seven per cent for mineral output, particularly that of anthracite and bituminous coal, copper and zinc.

Greater activity was shown also for leading lines of manufacture, notably iron and steel, paper and printing, and petroleum products. The production of food products, textiles and leather products, on the other hand, showed in 1926 little change from the year before.

The course of production throughout most of the year remained close to the high level of the late months of 1925. The advance in the early autumn brought industrial production to a new high level, about six per cent above the previous maximum reached in the spring of 1923. Production was at a relatively constant level from November, 1925, to July, 1926, and the rise in August and September to new high levels represented primarily increased production of iron and steel and automobiles, accompanied by a marked increase in the output of textiles, rubber tires, petroleum products, nonferrous metals and coal.

The increase in the early autumn in iron and steel was supported by demands from the automobile and building industries and to some extent by increased buying by railroads. The decline after September represented chiefly the decrease in automobile output, which in turn tended to reduce the demand for iron and steel. During the last two months of the year, however, there was a recession in almost all lines of manufacture.

INDIGO PRICES CUT IN SHANGHAI

The Shanghai market for dyes and indigos is in a state of upheaval at the present time, a price-cutting campaign being in progress between an American importing firm and several German houses, with the result that prices have been reduced on dyes and indigos, and in some cases sales were reported at a loss.

A price agreement is believed to be inevitable in the near future. (Consul-General C. E. Gauss, Shanghai.)

CORRESPONDENCE

TEXTILE WORK AT BUREAU OF STANDARDS

Editor, American Dyestuff Reporter:

We are very glad to note that your readers are interested in the textile work being done at this Bureau, as indicated by the editorial in your issue of February 7. It might be worth while, in view of this interest, to explain not only how much money we spend for this purpose, but what we do with this money, since this latter phase was not touched upon in your editorial.

A part of the fund appropriated for the "Investigation of Textiles, Paper, Rubber and Leather" is alloted as directed by Congress to investigations of textiles. At present this fund is being used for three projects: (1) The determination of the effect of the amount of twist on the physical properties of cotton yarn, (2) a study of the physical and chemical properties of rayon, (3) rendering the necessary assistance to the research associates and to the projects carried on transferred funds.

There are six research associates in the textile section. Besides rendering a general "trouble service" to their employers, these men are at present working on the following problems: (4) Development of a method for removing stains from cellulose acetate rayon. (5) The development of a method for cleaning fur and leather without impairing the pliability thereof. (6) The effect of the twist of the yarn on the shrinkage of knit goods. (7) The quantity of oil permissible in rayon. (8) The development of a stainless oil to be used for the lubrication of textile mill machinery. (9) Setting up standard sizes for underwear and for sweaters.

Some of our projects are carried on funds transferred by other Government bureaus for the solution of specific problems. Those at present active are: (10) The finding of a substitute for silk for parachutes. (11) The preparation of adequate specifications for parachute silk. (12) The development of test methods and specifications for manila rope.

The appropriation for "Industrial Research" is allocated to the solution of specific industrial problems throughout the entire field of the Bureau's activity. Occasionally some textile problem seems to be of sufficient immediate importance to warrant the use of some of this fund for its solution. At present two projects carried on this fund have to do with textiles: (13) An investigation of the properties of commercial dyes, and (14) the development of a method for the exact measurement of the color of textiles.

The textile section at present numbers eighteen men. The expense for administration, clerical help, supplies, equipment, travel, etc., is therefore no small item. Practically all of such expenses are defrayed from other funds which are appropriated by Congress to take care of such

overhead charges. These overhead funds also provide for one of the major items of our activities, (15) The routine testing of textiles for Government purposes.

The above is a brief picture of the present status of our work on textiles, detailing the output as well as the income. We hope it will be of interest to your readers as a supplement to your previous editorial, and wish to thank you for an opportunity to lay it before them.

Respectfully,

GEORGE K. BURGESS,

Director, Bureau of Standards, Department of Commerce, Washington, D. C.

LAUREL SOAP COMPANY WILL HAVE NEW HOME

A new two-story building of the most modern construction, fully equipped for the manufacture of textile chemical specialties, will when complete, constitute the new plant of the Laurel Soap Manufacturing Company located at Almond and Tioga Streets, Philadelphia. This concern produces soaps and oils for textile processing, and includes among its specialties several products of its own development.

The new building will be of reinforced concrete and will have a frontage of 80 feet on Tioga Street, and a depth of 180 feet on Almond Street. In the rear of the manufacturing plant and directly adjacent to it are a three-truck garage, boiler-room and steaming-out room for steaming oils from drums. This portion of the building is 30 feet by 80 feet, with a 90-foot radial brick chimney in connection with the boiler-room.

The general offices and the laboratory extend across the full front of the building on the Tioga Street side. The plant is so designed that extensions can be made.

A railroad siding and a loading platform is provided on the east side which takes in about two-thirds of the length of the building. The large soap boilers, which will increase the present capacity of this concern considerably, are located in the rear of the building directly adjoining the boiler-room. The pumping machinery and light storage of fats, oils, caustic, potash, etc., are in the basement, but remote control switches to all pumping machinery allows these materials to be delivered to any part of the building without the attendant being near the pumps.

The new building was designed and is being erected by the John N. Gill Construction Company, of Philadelphia.

STRIKE IN PACIFIC MILLS PROCESSING DEPARTMENT

A disagreement arising from the introduction of a time card system by the management of the Pacific Mills caused 150 employees of the dyeing and wet processing departments of the mill to stop work on February 28. The men are members of the Lawrence Industrial Textile Union, which is affiliated with the American Federation of Textile Operatives.

Dyes in Physiological Research

By W. MANSFIELD CLARK

Chief of the Division of Chemistry, Hygienic Laboratory, Bureau of the Public Health Service.

[EDITOR'S NOTE.—*The brief article below formed part of a review of the work of the Bureau of Chemistry of the United States Bureau of Public Health, recently published in the United States Daily. It is of unique interest as an exposition of the peculiarly intimate relation which dyestuff chemistry bears to the work of the physiologist.*]

THE importance of oxygen has dominated the thought of physiologists ever since the discovery of oxygen as the most significant element in our atmosphere; but even to-day the manner in which oxygen, once it is brought to the cells, enters intimately into the chemistry of life is so obscure as to be a subject of controversy.

The Division of Chemistry of the Hygienic Laboratory has found that several chemical processes which have been thought to be intimately related to oxidations in the living cell are not necessarily dependent upon the participation of oxygen, or for that matter, upon the element hydrogen which is supposed to be involved whenever oxygen acts to form water (H_2O). Instead, these processes are essentially exchanges of certain of the electrons contained in the substances taking part in the processes.

A noteworthy example is the bleaching of Indigo, formerly accomplished by bacterial fermentations, and now accomplished with certain chemicals called reducers. Essentially this type of bleaching is the driving of a pair of electrons into the dye molecule. The structure is then so changed that the substance no longer absorbs visible light and hence is colorless. By a well known electrical device, applied hitherto to inorganic compounds, the Division of Chemistry is measuring the driving forces with which one set of organic compounds, such as Indigo and its reduction product, tends to transfer its electrons to another set. It is thus building up a body of quantitative data with which there can be predicted in exact quantitative language the direction and extent of these electron transfers between specific sets of substances.

MEASUREMENT OF CELL ACTIVITY

The division has also measured directly, and indirectly by the use of the dyes it has studied, the driving force with which several species of living cells tend to alter organic compounds in the direction of a greater case of electron escapement. In certain cultures of bacteria, which are accustomed to live in the absence of oxygen, this driving force is found to be the highest which it is theoretically possible to attain without disrupting the molecules of the water in which the bacteria live. Workers in Europe are injecting into living cells the dyes, the electron-affinities of which are now known from the studies of the Division of Chemistry.

This "micro surgery" is being done with instruments

designed by Professor Chambers of Cornell University and is so delicate that high-power microscopes are necessary to watch the manipulation. If the results are confirmed they will necessitate radical revisions of the methods of attacking what the physiologists regard as the chief problem—namely, the manner in which oxygen enters the chemistry of life.

By the irony of fate the newer developments have deprived the physiologists of some of their favorite tests, but they have made these tests the subject of a new field of research—that of electron exchanges in which oxygen may never be directly involved.

While the chief accomplishment to date is a partial clarification of the confused and highly technical concepts which are concerned in this vitally important physiological subject, several incidental matters of some immediate importance have been studied. By the methods employed there are revealed exact data, hitherto unattained, concerning the chemistry of some common dyes and of new dyes which the division has designed and synthesized to fit its particular purposes.

By use of the concepts developed there has been gained an insight into the action of certain "oxidative" disinfectants such as iodine and chlorine, the latter being used extensively, it will be recalled, to lower the bacterial contamination of water supplies.

Other Biological Work Involving Color Tests

In addition to researches on the subject outlined, the division has synthesized some new indicators useful in determining the intensities of acidities (technically the hydrogen ion concentration) of biological solutions. It has developed a new test for cysteine, a substance which alone or in combination is very important in the oxidative and defensive mechanisms of the body. It has contributed to the theory of water clarification by alum with resulting savings in the alum bills of several municipalities. It made the chemical analyses in the recent investigation of possible hazards in the use of tetra ethyl lead. It has developed a new test for phenols, of which carbolic acid is a representative, and has described the essential chemistry of numerous other tests in a comprehensive review of the literature.

It is attempting to supply the biologist with a rational account of a certain type of color test used in the differentiation of cells, and known as the indophenol test. It carries on routine analyses of the arsenical preparations used in the treatment of syphilis and the manufacture of which is licensed by the Treasury Department, and it is developing new methods of analyzing these preparations with a view to stricter control.

Essentially the Division of Chemistry is a small research unit of nine active investigators where there exists an appreciation of the rapidity with which existing knowledge of the chemistry of living cells is exhausted in attempts to solve some of the more baffling problems of medicine and public health. It therefore concentrates its chief activity upon the problem first mentioned in this sketch with the confident hope that the solution will be of fundamental importance to very many problems of biochemistry and medicine.

PRODUCTS OF DYEING AND FINISHING RECORD INCREASE

Establishments engaged primarily in dyeing and finishing textiles during the year 1925 handled products valued at $432,537,416, an increase of 18 per cent over 1923 production. This interesting item of information has been announced by the Department of Commerce and is based on its biennial census of manufactures taken last year.

The establishments classified in this industry are those whose principal operations are the bleaching or dyeing or the mercerizing, printing, or other converting of yarn or cloth, the beaming or winding of yarn, or the spooling of thread (except the winding and warping of silk). The majority of the establishments operate on a contract or commission basis, but some of them own the goods dyed or finished. Of the 697 establishments reporting for 1925, 166 were located in New Jersey, 151 in New York, 148 in Pennsylvania, 65 in Massachusetts, 63 in Rhode Island, 16 in Connecticut, 14 in Illinois, ten in North Carolina, eight in Ohio, eight in South Carolina, six in California, six in Georgia, six in Maryland, five in Indiana, and the remaining twenty-five in thirteen other States. In 1923 the industry was represented by 713 establishments.

TOLHURST EXPOSES IMPOSTER

The following self-explanatory letter has been received by American Dyestuff Reporter from Tolhurst Machine Works:

"We have been informed that a man using one of the following names—Cummings, Butler or Burton—has been representing himself as employed by or as a former employee of the Tolhurst Machine Works. He used a business card bearing our name and address together with the name 'Cummings.'

"Will you kindly publish in a prominent position in American Dyestuff Reporter a notice that the man is an imposter, as he is not, nor never has been employed by this concern under the name 'Cummings.'

"Thanking you for your assistance, we are

"Very truly yours,

"Tolhurst Machine Works,

"R. K. Cheney, Sales Manager."

Newport Chemical Works, Passaic, N. J., is arranging for rebuilding the portion of its plant recently destroyed by fire with loss of $21,000.

The Accurate Determination of Costs

Price Fixed by the Market—Tradition in the Way—Present System Needs Study—The Management of Men

By JAMES BROHEL

[EDITOR'S NOTE—*The following address was delivered by Joseph A. Brohel, comptroller of the United Piece Dye Works, Lodi, N. J., at the dinner of the Silk Dyers' Protective Association in Paterson, N. J. It is here reprinted from "Silk."*]

SINCE the days of Taylor, who measured each operation in cost analysis with a stop-watch, every manufacturer or production manager immediately assumes a frozen attitude whenever you say the word "costs" to him. He has visions of strangers wandering through his plant questioning operatives, interfering with processes, etc., etc. Also he visions a new force of clerks who are steadily engaged compiling statistics; which, of course, seems to him as another burden of expense without any apparent recompense or return.

Please recognize this fact: I am not a tyro in cost accounting, so called. In fact, I do not believe I could keep a set of books, though I may be able to direct their keeping and vouch for the correctness of the balance sheet.

Being unable to tell the difference between flat crepe and crepe-de-Chine, I will not attempt to analyze the difference in methods as to various operations that take place in the passage of a piece of silk from receiving and marking rooms, through the various mill ramifications to the shipping department.

The word "costs" has a certain allurement to most manufacturers, in that they feel if they find their cost they can more quickly determine what their profits will be. To my way of thinking, that is a false notion and will eventually cause trouble with the sales department.

PRICE FIXED BY THE MARKET

No dyer and finisher can definitely fix a selling price from a cost obtained by following the merchandise through each step in the process until he has corrected his shortcomings in method and efficiency. The final price obtained for the merchandise is not fixed by the producing plant, but by the market—or rather the price your competitors are asking for a similar product. Of course, there is some predetermination in a general way, such as how many yards did we do last year and how much were our total expenditures, resulting in an average which was forgotten every time you ran up against stiff competition; and then you woke up some time later and found you were doing an ever-increasing business in tub silks, we'll say, at three cents per yard, and then you wondered why the pay roll consumed all the bank balance.

In this connection I might relate an actual experience: A production manager who believed he knew the principle of cost keeping, because "didn't he run the mill and know what his people could do?"—mark you, *could* do. The cost department with figures on labor compiled from the work tickets as to the actual time employed and figured on the amount paid for it, the actual amount of material used (no guesswork or conjecture about it) from the time the merchandise entered the mill office until it left through the shipping room; each step was accurately charged and a cost ascertained for a definite yardage, from which it was an easy matter to determine the cost of a given yardage, no matter what the quantity. He questioned the figure as being too high, giving his analysis as follows:

He estimated in each department the number of operatives required to handle a given amount of yardage; this he multiplied by an arbitrary daily wage figure; this was again multiplied by four to cover material, operating and general expenses—and he still wonders why the cost department could be so far wrong.

A true functioning cost department that will take up different qualities and follow the lots through each step in the dyehouse will exhibit more faults in method than you ever dreamed were there, and it will in 90 per cent of its conclusions do more to increase efficiency in producing methods than any bonus scheme ever yet devised, at the same time being of inestimable aid to the production head in pointing out excesses or inefficiently run departments.

TRADITIONS IN THE WAY

The difficulty in getting away from old traditions is still a dyehouse tragedy. "My father's way"; the dye boss' law of primogeniture that it must be all in the family; "the rule of thumb"; the secret mixtures of the "finish kitchen," and so on *ad libitum*, still prevail in many establishments at the present day. You will learn, when you attempt to find the exact cost of dyeing a lot or finishing a lot, that you will run up against some of these snags. Then will be your opportunity to demonstrate that the business is bigger than the man, whether he be the president of the concern or the "wool and silk dyer."

I would classify the cost in our line of piece dyeing and finishing into four great subdivisions of material, labor, operating expense, and general expense.

Material—Would embrace all merchandise purchased and which was consumed in various processes.. To control this a central storehouse would dispense merchandise to the various departments on requisition and would keep proper records of receipts and disbursements of material,

and they would know nothing of the costs of the raw material. The work tickets should contain an accurate record of all material used at the various steps of the merchandise through the mill. A perpetual inventory for the warehouse and a monthly physical inventory by each department will act as a check on the correctness of these charges.

Labor—In the production departments there are three kinds of labor: hourly, weekly, and supervisory. All are necessary and are part of the producing costs. Control timekeeping records by timekeepers, with separate reports by foremen, insure reasonable accuracy.

Operating Expense—Should include mechanical running and upkeep, including water and steam.

General Expense—Should include all costs of administration, such as executive salaries and compensation not included in production or operating salaries or charges, administration offices, taxes, postage and stationery, insurance, depreciation, etc., etc.

These four divisions of expenditure can be further subdivided as special requirements may justify.

You know the story of the country storekeeper who, when asked how much it cost him to do business, said: "Not a cent. I own my own building and don't have to pay any rent. My wife and son wait on the trade, so I don't have to pay any salaries. I keep my own books and send out my own statements, and my youngest son takes care of the delivery with our own horse and wagon. So, you see, it doesn't cost me a cent to do business—not a cent."

System Needs Study

The method of charging for silk piece goods on the finished yardage will bear close scrutiny and study. Whether it be a modification of the foreign one of per pound gray weight, or a unit price per yard gray weight, with proper shrinkage allowance, or some system other than the present one uniformly agreed upon, would do much to stabilize prices, enhance profits and discourage claims.

A few days ago one of our salesmen told me of a happening in the trade. He asked a certain merchant how he could put out a particular piece of goods for $1. The merchant said the silk cost 86 cents and the dyeing charges were 14 cents, making $1. Yes, but how about the overhead? "Overhead?" said the merchant. "There is no overhead; the goods won't stand it."

As to the correctness of the unit or basis employed there is much that can be debated. The old custom of designating the piece as the unit frequently led to error in calculation because of the various lengths in pieces received and shipped; therefore, the only unit available under the American method is the yard. A discouragement in using the word "piece" throughout the plant will help to eliminate it as a basis.

Reports as to the yardage of different qualities handled by each department should be sent to the cost or statistical department each day, and there be compiled for use.

Periodical reports of goods rehandled should be made by departments at short periods.

An accurate cost of manufacture is as yet unknown. A true or commercial cost is all that is expected or that can be ascertained. Many people fall into error and say that a cost is not correct because not accurate, not stopping to realize that to obtain an accurate cost would require all the instruments of precision now in the Bureau of Standards at Washington.

The Management of Men

The true secret of production lies in the management of men—whether we dye silk or cut cordwood. The best method of labor compensation is still the subject of feverish search by economists and engineers. It is not always how much you put in a man's pay envelope, but the goodwill and recognition in which it is wrapped, that counts more to-day than ever before. The efficient management of a business lies not in how much net profit have we made, but how greater have we built it.

I hope that from my crude talk you have gleaned something of use in our kindred lines that will be of service and help, at least in a small way; that in competition we may establish a code of business ethics which will permit us to grasp each other's hand in salutation without wondering what each has up his sleeve.

SEASONAL CHART OF COLOR HARMONIES ISSUED

A chart of color harmonies for spring and summer, arranged by Margaret Hayden Rorke, managing director of the Textile Color Card Association, has just been issued to the members of the association.

The chart shows what shoe and hosiery colors combine with the millinery and garment shades. Artistic color ensembles are suggested, such as a blue gown, gray and violet in cast, Shell Gray shoes and Moonlight Gray hosiery. With the rosy beige tones are combined Pastel Parchment shoes and Pearlblush or Sandust hosiery.

Mrs. Rorke has chosen as the fashionable spring colors, blues, beiges, grays, greens and rose and red shades. She also includes mauve and violet tones and black and white combined. For evening colors, she has selected white, cream, flesh, pink, blue, yellow, green, orchid and gray, "all delicate in tone." Also brighter shades of rose and red. All black, and white combined with black. The modish sport colors she considers to be rose, yellow-orange, red, pale beige and natural kasha shades as well as all the delicate hues listed under evening colors and white and black combined.

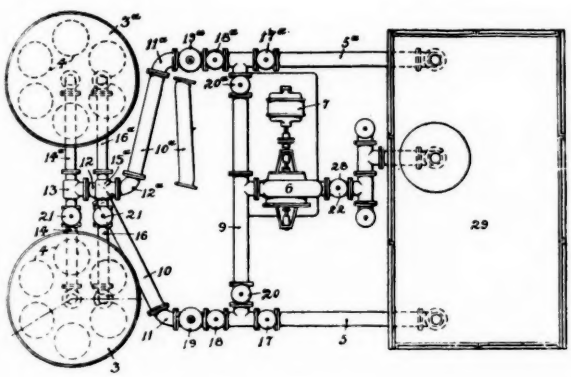
All the colors indicated on the chart are taken from the 1927 Spring Color Card of the Textile Color Card Association, and from the Shoe and Hosiery 1927 cards of that association.

Technical Notes from Foreign Sources

Wet Treatment of Wound Textile Material

German Patent No. 428,484 is concerned with an apparatus for the wet treatment, that is, bleaching, dyeing, and the like, of textile materials with a reversible circulating liquor.

The pressure pipe of the pump opens out into two pressure tubes, each of which leads to the liquor container, near a suction tube which the pump connects with the same liquor container. Inasmuch as the pressure pipe leads into the liquor container and can be closed off by means of valves from the closed dye liquor container, then the circulation of the pump can be accomplished without any difficulty only in combination with the liquor container for the purpose of mixing the liquor.



The figure shows an arrangement which is used for this purpose. The two vessels or the closed dye liquor containers are designed by 3 and 3ª and these contain six perforated tubes or spindles on which the textile materials are wound. The pressure connections are shown at 5 and 5ª, leading to the liquor container 29, while 6 is the circulating pump. The pressure line of the pump 6 is connected with the a pipe 9, to which both 5 and 5ª are also connected. The pump 6 is connected with the pressure line 28 which is connected with the liquor container 29.

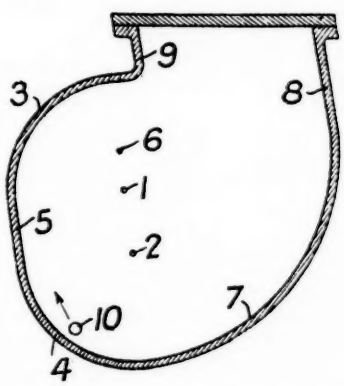
The pressure line 5 is connected by the bend 11 with the tube 10 which is also connected with the T tube 13 through the bend 12, from which connecting pipes 14 and 14ª lead to the dye liquor container. These connecting pipes open out in the lower chamber 15 of the two tanks 3 and 3ª. In a similar manner the pressure line 5ª is connected with each of the two dye liquor containers 3 and 3ª through the bend 11ª, the pipe 10ª, the bend 12ª, the T tube 13ª and the connecting pipes 16 and 16ª. Each of the two pressure lines 5 and 5ª is provided with a valve, of which 19 and 19ª are designated as three way valves. A check valve 22 is located on the suction line 28, by means of which the pump 6 is placed in direct connection with the liquor container 29.

The wet treatment of the textile as accomplished in the following manner: The valves 17ª, 20, 18, 18ª, 19, 19ª and 21 are opened; the other valves 17 and 20ª are closed, and the three way valves 19 and 19ª are connected with the pressure lines 5 and 5ª. The liquor is now sucked by the pump 6 from 29 through the pipe 28 and is led through 20, 18, 19, 10, 14 and 14ª into the two containers 3 and 3ª. The liquor passes through the textile, then flows into the lower chamber 15 and from this to the liquor container 29. The reversal of the flow of the liquor can be accomplished without changing the direction of circulation through the pump, in a simple manner, by closing a valve, for example, 20ª on the pipe 9 and another valve, for example 17, on the connection 5 or 5ª and opening the corresponding valve s, for example 20 and 17ª.

Dyeing Tank

Knitted, woven and other articles are dyed in a non-annular tank in which a compressed air inlet is arranged so that a free circulation of the dye liquor and goods is obtained wholly within the tank. The air inlet 10 may be arranged adjacent and parallel to one wall of the tank. The air may be preheated, steam jets may also be used in conjunction with air jets, while paddles, etc., may be employed to air the circulation. The wall of the tank adjacent to the inlet 10 curves inwardly to guide the liquor in its curved path.

The dimensions of the tank are given as follows: A unit of dimensions is the distance between the



points 1, 2, this distance equalling the length of the vertical wall 5 which joins the quadrants 3, 4, whose radii are from one and one-half times to twice this basic distance. The radius of the quadrant 7 is from three to four times this distance, and the width of the

opening between the vertical walls 8, 9 is from 2.25 to 3.25 times this distance. The path of the liquor and goods is an ellipse with its major axis vertical, and when two sets of inlets 10 are provided for reversal of the circulation, the quadrant 7 may be replaced by a wall corresponding to the sections 3, 4, 5. (British Patent No. 259,323.)

Making Cuprammonium Silk

The crude filtered viscose solution is fed by a pump through tubes, which are surrounded by a cooling medium, to a mixing chamber which is constituted of rotary blades or stirrers bearing against the outlet ends of the tubes from which the solution is issuing. In the stretch spinning process of cuprammonium solutions of cellulose the coagulating liquid is fed into the spinning funnel or cylinder from below under atmospheric pressure. The upper portion of the funnel, where the head carrying the spinning nozzle enters the liquid, is closed, while the lower open end is suspended below the surfaces of the liquid in a tank, but a suction orifice is provided at the top through which the air can be exhausted from the funnel when the operation is being started up. Circulation and replenishment of the liquid in the cylinder are effected by the surface friction of the threads passing downwards through the column of liquid in the tube.

The cuprammonium solution is fed under pressure to a measuring pump comprising a casing in which is a cylindrical rotary member containing radially disposed recesses and sliding pistons, the latter being actuated by projecting pins and runners which engage in eccentric grooves formed in the side cover-plates. The quantity of fluid discharged by the pump is finely adjusted by mounting the side cover-plates in flanged rings, in which they can be rotated through a small angle so as to vary the position of maximum throw of the eccentric grooves in relation to the outlet. The feed inlet may also be controlled by a screw-adjusting plunger with a conical end. (British Patents Nos. 258,371-258,373.)

Insoluble Colors on Cellulose Acetate

Cellulose acetate absorbs and fixes many intermediate compounds, diazo and tetrazo compounds as such, and the process, originally described in the Journal of the Society of Chemical Industry, 1894, volume 13, page 388, for the production of insoluble colors on animal fibers has now been applied to the dyeing of acetate rayon. Thus, cellulose acetate is worked for a few minutes in a fine suspension which is obtained by pouring into water a hot alcoholic solution of beta naphthol, washed from mechanically adherent naphthol, and passed into a solution of diazotized para-nitraniline. The process may be reversed. Intermediates such as phenylmethylpyrazolone, which are soluble in water, afford much deeper shades if a little alcohol is added to the aqueous solution to produce a fine suspension. Para Red may also be produced on cellulose acetate by passing the rayon through the mixed suspension of the components in dilute alcohol and then washing and diazotizing. Meldola's Blue may be similarly developed on cellulose acetate rayon by the use of a mixed suspension of beta-naphthol and para-nitrosodimethylaniline and steaming.

Toluylene Blue, when similarly produced on cotton, silk and viscose rayon, on further steaming changes into Neutral Red. On cellulose acetate rayon the blue does not change either on prolonged steaming or on hot soaping, but alters on storing within three years. Aniline Black may be developed on cellulose acetate rayon by working the material in the suspension of Diphenyl Black Base I, washing and oxidizing in a solution of ammonium chloride, sodium chloride and a vanadium solution. (Journal of the Society of Dyers and Colorists, 1926, volume 42, pages 345-348.)

Dyeing Leather

Basic dyestuffs give full shades on chamois leather, but are not easily absorbed and retained if the leather contains chromium salts. Unchromed chamois leather will retain 1 per cent of the basic dyestuff in the surface layer. The basic dyestuff diffuses evenly through the chromed chamois leather. Direct dyestuffs alone are of little use in dyeing chamois leather. Acid dyestuffs will dye chamois leather whether retanned with chromium salts or not. It is suggested that both the basic dyestuffs and the chromium compounds combine with the acid groups in the hide substance molecule. Hence, all the chamoising must affect these groups very little, if at all. Chroming of chamois leather does not affect the dyeing with acid dyestuffs, hence the chromium salts cannot combine with the free basic groups in the chromois leather.

Chrome leather was dyed with 2 per cent of Primuline Extra, Chlorazol Brown GM or Chlorazol Brown M, without the application of tannin, then washed and drummed in 500 per cent of water, figured on the weight of the stock, containing 4 per cent of hydrochloric acid and 2 per cent of sodium nitrite. The process lasted for twenty minutes at the lowest possible temperature. After rinsing the dyed leather was transferred to a solution of 0.3 per cent of phenol, resorcinol, alpha- or beta-naphthol and one-tenth of a per cent of sodium hydroxide or a solution of 0.3 per cent of metaphenylenediamine and 0.14 per cent of soda ash. This coupling process changed the color, but it was fast to water, hot soap solution, sun, air, and 1 per cent sodium carbonate solution. The dyed leather should be treated with ½ per cent of borax solution to neutralize any acid left from the diazotiz-

ing process. (Journal of the Society of Leather Trades Chemists, 1926, volume 10, pages 168-171, 197-199.)

Oil Spots on Cotton and Linen Goods

It is very easy for fabrics to become spotted with lubricating oil and like spots during their manufacture and frequent contact with machines of all sorts. If the fabric is thereafter dyed in dark shades, these spots make very little difference, but when the fabric is dyed in light shades then the presence of oil spots can introduce many difficulties. For these oil spots are not removed in the preliminary treatments that the fabric undergoes before it is dyed, such as boiling-off and the like, as the oils are unsaponifiable. The spots are not wetted down in the dye liquor in the same manner as the rest of the fabric and the result is dyed goods in which the oil spots show up as lighter colored places. Furthermore, the metallic particles that are always contained in the mineral oil introduce additional difficulties.

In order to avoid this trouble it is common practice in the textile industry to use clear, transparent oils. Nevertheless, these oils must also be saponifiable, for otherwise they are not removed from the goods in boiling. The animal and vegetable oils belong to this class; however, these oils have the very troublesome property of oxidizing and becoming rancid. On the other hand, there are certain exceptions too expensive to be used for this purpose. The best practice, therefore, seems to be to use a mixture of the animal or vegetable oils with mineral oils, for then the mineral oil is found to be easily emulsified on boiling and thus can be removed in the boiling operation.

Removal of Oil Spots

There are, of course, various ways in which oil spots can be removed from fabrics. One of the simplest methods is to treat the goods with volatile solvents, such as benzine or carbon tetrachloride. The latter is best suited for this purpose as it does not form rings around the spot. The solvent can be directly applied to thin goods until the fabric is thoroughly impregnated and then it is squeezed between dry linen cloths; on the other hand, when the cloth is thick the spot should be removed by means of a linen rag dipped in the solvent. In the latter case it is necessary to see that the fabric is well wetted with the solvent. When the spots are old, it is advisable to moisten them with fresh oil, for then the spots are more easily removed. This pertains particularly to crude oil spots.

Good results are obtained with the following method, particularly applicable to bright colored fabrics. The spots are moistened with oil and then covered with a thin layer of a paste consisting of fullers' earth mixed with water. The paste is allowed to remain for some time, then removed and the fabric washed in cold or lukewarm water. This process must be repeated a number of times in order to remove all traces of the spot.

The following method is applicable to undyed fabrics which have been spotted with mineral waxes and fats. The spot is moistened with oil and then the largest portion of this oil is removed by means of a wooden spatula. Then the fabric is washed in a mixture consisting of 500 grams of water, 20 grams of magnesium sulphate, 5 grams of benzine and 5 grams of oxylite, at a temperature of 35 to 45 deg. Cent. The spotted portions are then well brushed.

The metallic particles in the oil spot are removed by treatment in the usual manner with oxalic acid for iron or with 10 per cent hydrochloric acid for iron and copper. (Deutsche Faerber Zeitung, 1926, pages 1166-1167.)

NEW INDIGOSOL BLUE ANNOUNCED

An addition to the series of Indigosol Blues for calico printing, manufactured by Durand & Huguenin S. A. of Basle, is a new color known as Indigosol HB. The announcement is made by Carbic Color & Chemical Company, of New York, agents in this country for the Indigosol colors.

Indigosol HB, according to the description, possesses good fastness properties and is easily applied. It is said to be soluble in water, quite stable and useful for print-on as well as for resist styles. As the unsteamed prints may be developed by any steaming apparatus, the color is also of some value for block and yarn printing. The steaming process yields deep violet-blue shades described as of very good fastness to washing and chemicking and of good fastness to light.

FAST YELLOW AND ORANGE ADDED TO AMACID RANGE

Two new additions to the series of Amacid colors manufactured by American Aniline Products, Inc., have been announced under the names of Amacid Fast Light Yellow 2G and Amacid Fast Orange LW.

The Fast Light Yellow is described as of a greenish tone, corresponding with its foreign prototype, and as being among the fastest of its class available. It is said further to be leveling dyeing and of excellent fastness to pressing and salt water. Effect threads of cotton and Celanese are left clear, while silk threads are stained. It is claimed to be of special value for the dyeing of dress goods, carpets and upholstery material.

Amacid Fast Orange LW, according to the announcement, is an acid orange of good general fastness properties and represents a special development of its manufacturer. Its solubility is said to be good, while its fastness to light, salt water and stoving is

described as excellent, and to washing and heat as good. Rayon and cotton effect threads in fabrics dyed with this color are left clean, it is further claimed, and silk threads are unstained when acetic acid is used. It is therefore recommended for dyeing dress goods where effect threads come into consideration. It is described as also suitable for bathing suit material and for the production of lakes.

BENZO RED ASSESSMENT CORRECTLY BASED ON U. S. VALUE

According to a decision handed down by the United States Court of Customs Appeals, in the case of a shipment of Benzo Red imported several years ago by Kuttroff, Pickhardt & Co., Inc., New York, this color was not properly assessed for duty on the basis of the American selling price, but was entitled instead to a rate based on the American valuation. The Custom Appeals Court had supported the importer's contention that the Board of Appraisers had failed to justify its findings, and its final decision reversed this board's judgment.

The color had originally been held competitive to Pontamine Fast Pink G, a domestic product and appraised at $2 per pound, based on the American selling price of the domestic product. The single general appraiser affirmed this appraised value. The United States Board of General Appraisers agreed with the single general appraiser as to the correctness of the basis of his appraisement, but found the value to be $7 per pound.

The appeals court in deciding the case said: "Since the reappraisement of the single general appraiser was based upon the American selling price of Pontamine Fast Pink G upon insufficient testimony his finding cannot be approved. The United States value of the merchandise should have been determined by the single general appraiser and accepted as the correct dutiable value. The judgment of the board of United States General Appraisers (now the United States Customs Court) is reversed."

NEW DISCHARGE PRINTING ASSISTANT

The Dyestuffs Department of E. I. du Pont de Nemours & Co. has placed on the market Leucogene W for use in the discharge paste, applied to Indigo dyed materials.

Reduced Indigo rapidly reoxidizes back to blue causing trouble during the washing. Leucogene W, it is claimed, prevents reoxidation of the reduced dyestuff by reacting with it to produce a yellow dyestuff which is soluble in hot, dilute alkaline solution and can be washed out when convenient.

DUNKER & PERKINS MERGES WITH KLIPSTEIN COMPANY

The dyestuff and textile chemical business of Dunker & Perkins Company, which has been located for a number of years at 263 Summer Street, Boston, Mass., was taken over on March 1 by A. Klipstein & Co., of New York. The Boston offices of the latter company will be removed to the quarters occupied by Dunker & Perkins Company. The formal announcement of the merger follows:

On March 1, 1927, the business of the Dunker & Perkins Company was merged with that of A. Klipstein & Co. The offices of the latter company, now at 283 Congress Street, will be removed to 263 Summer Street, Boston, Mass. Telephone Liberty 5246-7-8.

Mr. Charles H. Dunker and his associates will join the Boston staff of A. Klipstein & Co., and will continue to serve their trade and friends in the same zealous manner as in the past.

The same agencies and excellent facilities maintained by Dunker & Perkins Company with ample stocks for immediate delivery and laboratory service will be continued.

The enlarged organization and the combined knowledge and experience, gained through many years of close contact with the industries served, we gladly put at your disposal in the hope that our friendly relations may be extended.

Dunker & Perkins Company
Chas. H. Dunker, President

A. Klipstein & Co.
A. Klipstein, President.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i. e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

CHEMIST

Has specialized thoroughly in the analysis, manufacture and application of sizings, softeners and finishing materials and general adhesives. Technical graduate; experienced, capable worker. At present employed. Seeks connection offering opportunity for advancement. Reply Box 376, American Dyestuff Reporter.

FOR SALE

A complete Dyeing and Finishing Plant located in the Central West, fully equipped with modern machinery; land and buildings suitable for expansion, equipped for the dyeing and finishing of upholstery, denims, dress goods, coatings, cloakings, etc. Reply Box 375, American Dyestuff Reporter.